

X-RAY GENERATION

LIST OF DOCUMENTATION IN THIS BINDER:

- ⊗ SUBSYSTEM MANUAL OPTIMUS
- ⊗ UNIT MANUAL Converter R/F
- ⊗ UNIT MANUAL Cockpit for duo DIAGNOST
- UNIT MANUAL Power Distribution Unit (PDU)

Note: ⊗ indicates document present

LIST OF ALL BINDERS FOR X-RAY GENERATION:

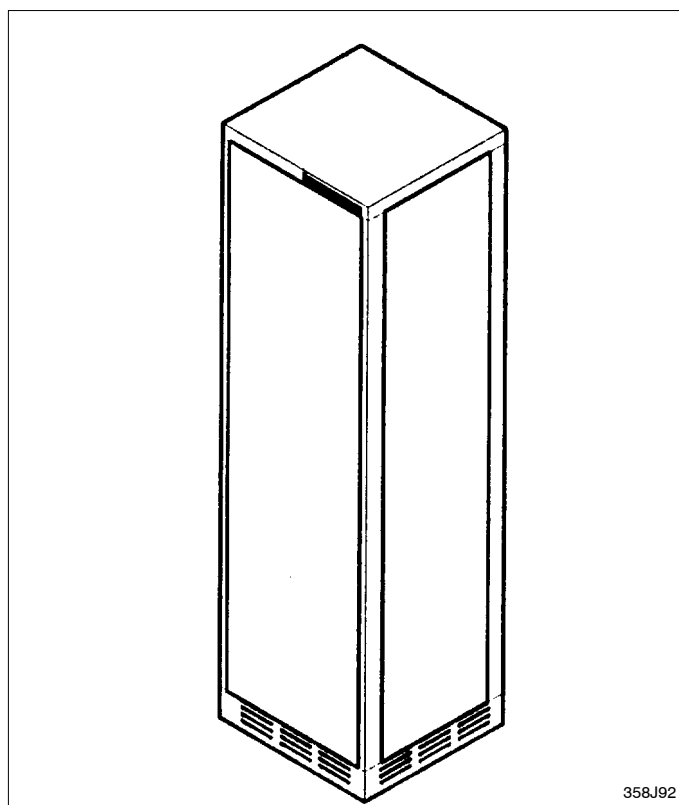
- SUBSYSTEM MANUAL OPTIMUS C (this binder)



**SERVICE MANUAL
742
SUBSYSTEM**

OPTIMUS C

9890 000 02191



CAN-controlled X-ray generator of the converter type

DMC Hamburg

Printed in Hamburg, Germany

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SERVICE MANUAL - SUBSYSTEM**OPTIMUS C**

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Type No: 9890 000 02191

Techn. No: Basis 4512 104 70625

Release: 1.2

In case there are any questions concerning this manual,
please send this LOPAD via fax to 49/(0)40/5078 2481

File: OPTIMUS_C_08497_AC

List of pages and drawings (LOPAD)**Manual Order No: 4512 984 08497****released: 06/2003**

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1. Product information

The Optimus family of generators for radiography is based on computer-controlled converter technology. The converter operates in the non-audible frequency range.

Applicable options can be enabled by releasing software modules using customized PAL ICs depending on the respective order.

Control between the internal **F**unction **U**nits (FUs) and the external online equipment takes place by a CAN bus.

Safety-relevant signals are transferred directly on the so-called "Signal bus".

1.1. Applications

- Radiography
- Tomography
- Fluoroscopy

1.2. Options

1.2.1. Hardware options

- Mains transformer PDU: 400 – 480V; 50 / 60Hz,
also for 400V mains supply without neutral lead N
with taps for 400 / 440 / 460 / 480V 9890 000 0260x
- Mains transformer: 190–390V; 50 / 60Hz
with taps for 190 / 200 / 207 / 220 / 230 / 240 / 250 / 343 / 380 / 390V
max. 50kW! 9803 720 8100x

1.2.2. Software options

Software options are provided via the function key (see also 5Z-1, EZ 139 Central Unit D38). Additional hardware components are not required.

All system options are available.

All Optimus C have the same function key configuration, there is only a difference in the power class 50/65/80kW.

2. Compatibility

2.1. Generator components

- Base OPTIMUS C 9890 000 0219x
- H.V. transformer R/F .. 1 tube, 50kW 9890 000 0270x
- H.V. transformer R/F .. 1 tube, 65/80kW 9890 000 0272x
- 50kW extension – R/F 9890 000 0274x
- 65kW extension – R/F 9890 000 0275x
- 80kW extension – R/F 9890 000 0276x
- Firmware Rel. 1.2 9890 000 0254x

2.2. Tubes

Recommended standard tubes:

- RO 17 50
- SRM 06 12
- SRO 25 50
- SRO 33 100

Further compatible tubes:

- | | | |
|---------------|-------------|--------------|
| - RO 12 30 | - SRO 09 51 | - SRO 20 55 |
| - RO 16 48 | - SRO 13 30 | - SRO 22 50 |
| - RO 30 50 RE | - SRO 20 50 | - SRO 32 100 |

Compatible tube housings:

- ROT 350
- ROT 351
- ROT 504

The latest information on further tubes which are connectable is available at the service center Hamburg.

2.3. System components

- DuoDiagnost GEOMETRY 9890 000 0290x
- Stand for operating panel 9890 000 0244x
- Wall mounting of operating panel 9890 000 0245x
- User interface support 9890 000 0283x
- Cable set for COCKPIT 9890 000 0279x

3. Mechanical data

For installation dimensions and weights see drawings Z-1.1.

Transport data:

Case no.	Contents	Weights [kg]		Dimensions [cm]		
		net	gross	length	width	height
1	- Generator cabinet - Operating panel - Cables	178	226	210	82	84
2	- H.V. generator; 1-tube version	73	100	77	67	80

4. Environmental data

The environmental data comply with to PMS standard UXW 13600.

4.1. Electrical environment

Class S0 – Dedicated mains supply, 3 phases and neutral. Thus single phase voltage is also available.

A low impedance, permanently installed connection, fed in by the step down transformer of the hospital to supply large systems like in MR, CT and X-ray departments is required.

Note

Use always a mains cable with 4 wires and concentric PE-shield, type NYCY.

4.2. Climatic conditions

Ambient temperature 10°C – 40°C

Relative humidity 15% – 90%; no condensation

Relative atmospheric pressure 70kPa – 110kPa

4.3. Emission

Heat dissipation max. 1200W; average per hour

Noise level, normal operation ≈ 46dBA

Noise level, maximum power operation ≈ 55dBA

EMC IEC 950

To avoid any possible annoying noise of the implemented fans it is advisable to install the generator cabinet outside the examination room.

5. Electrical data

5.1. Power data and mains conditions

	Voltage		
	50kW	65kW	80kW
Mains voltage	3 x 400V $\pm 10\%$ (415V $^{+6\%}$ / 380V $_{-5\%}$)		
	3 x 400 / 440 / 460V $\pm 10\%$ *		
	3 x 480V $^{+6\%}$ | $_{-10\%}$ *		
	* = with external transformer PDU (option) The following connection cables are recommended: Input: 3 + 1 x 10mm ² (L1, L2, L3, PE) Output: 4 x 4mm ² Generator supply 3 x 400V 4 + 1 x 4mm ² Device supply 3 x 220V (option) 3 x 1,5mm ² Switch control and temperature supervision		
	3 x 190 ... 343V $\pm 10\%$ **		
	** = with external transformer; max. 50kW (option)		

	Frequency		
	50kW	65kW	80kW
Mains frequency	49 ... 61Hz		

Voltage		Max. mains current		
		50kW	65kW	80kW
Exposure:	400V	145A	190A	230A
	440V	135A	180A	215A
	460V	125A	170A	210A
	480V	120A	160A	205A
	190V	300A	-	-
Short-time power consumption [I x U x √3]		100kVA	132kVA	160kVA
Fluoro:	400V	-	8A	
	480V	-	7A	
Fuse protection (slow blow)		35A	50A	
		100A at ≤ 240V		
Connected load [I _{Fuse} x U x √3]		25kVA	35kVA	
Emergency power supply:	static (Inverter)	Short-time power consumption [I x U x √3]		
	dynamic (Diesel generator with flywheel mass)	Connected load [I _{Fuse} x U x √3]		

Voltage		Mains resistance		
		50kW	65kW	80kW
400V		$\leq 300m\Omega$	$\leq 200m\Omega$	
440V		$\leq 350m\Omega$	$\leq 240m\Omega$	
460V		$\leq 350m\Omega$	$\leq 240m\Omega$	
480V		$\leq 400m\Omega$	$\leq 300m\Omega$	
480V valid for DOD only		$\leq 300m\Omega$	$\leq 240m\Omega$	$\leq 180m\Omega$
		Note <i>500mΩ is the absolute max. mains resistance.</i>		

5.2. Power supply for application

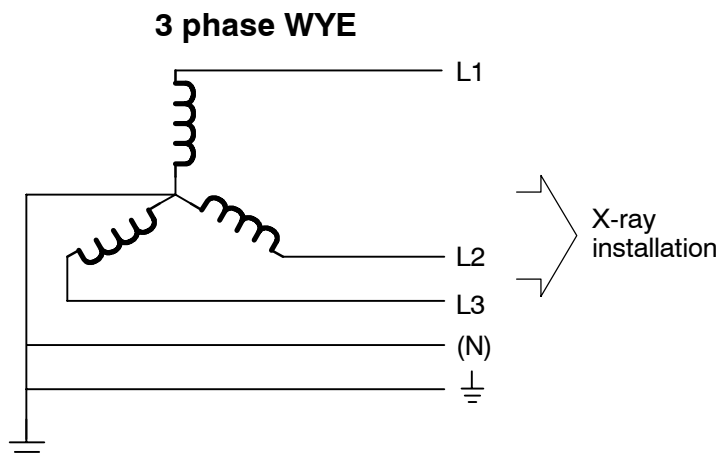
Supply	Generator power		
	50kW	65kW	80kW
Output 1	230V / 400V; generator switched and protected		--> I ₁
Output 2	230V / 400V; generator switched and protected		--> I ₂
Output 3	230V / 400V; generator not switched and protected		--> I ₃
	Sum value I _{max} (1 +2 +3) ≤ 10A		
Only with external transformer PDU			
Output 4	127V / 220V generator switched and protected		--> I ₄
Output 5	double socket 127V / 15A to phase L1; generator not switched and protected		--> I ₅
	Sum value I _{max} (4 +5) ≤ 16A		

5.3. Operating data

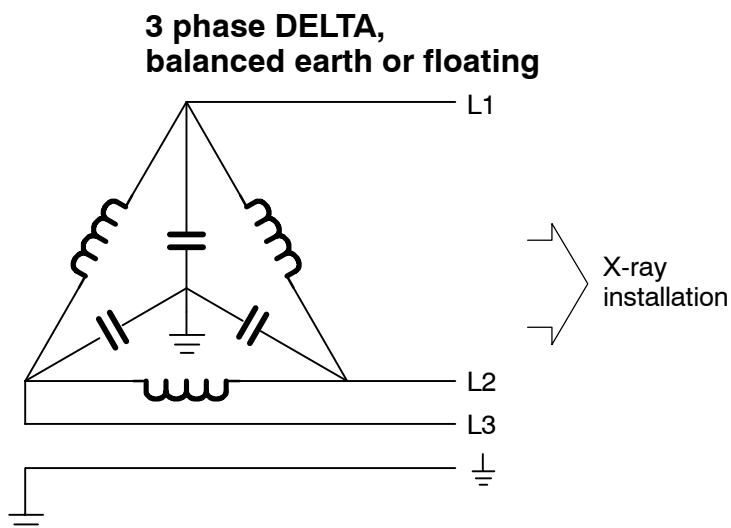
Data	Generator power		
	50kW	65kW	80kW
Exposure: Tube current	1 ... 650mA	1 ... 900mA	1 ... 1100mA
Tube voltage	40 ... 150kV in kV- or %-steps		
mAs product	0,5 ... 850mAs		
Exposure time	1ms ... 6s / 16s		
Exposure frequency	≤ 12exp./s		
Interfacing option for	door contact, external radiation warning indicator		
Fluoro: Tube current	0,25 ... 6mA		
Tube voltage	40 ... 110kV		
kV/mA curves	3		
Setting time	≤ 1s		

5.4. Power supply

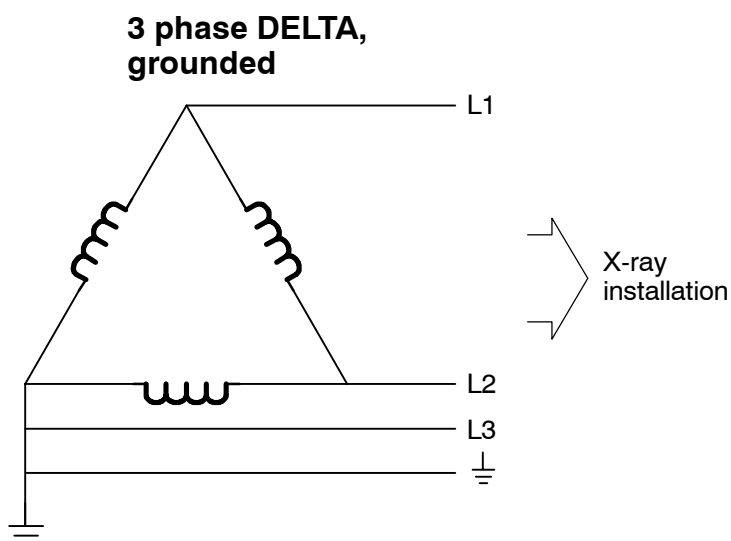
5.4.1. Type of power supply



- 400V
- 440V / 460V / 480V with external mains transformer PDU 9890 000 0260x.
- Neutral not required if the external mains transformer PDU 9890 000 0260x is ordered.
- 190V ... 343V with external mains transformer 9803 720 8100x (max. 50kW).



- External mains transformer PDU 9890 000 0260x is required.
- 400V / 440V / 460V / 480V
- 190V ... 343V with external mains transformer 9803 720 8100x (max. 50kW).



- External mains transformer PDU 9890 000 0260x is required (requires modification at the EMC-filter of the kV power unit).
- 400V / 440V / 460V / 480V

Caution!

Ensure the sequence of phases in the wall junction box corresponds to designations L1, L2, L3.

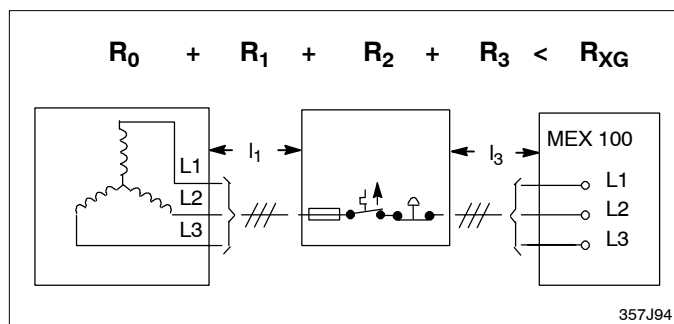
5.4.2. Calculating the mains resistances

Note

The cross section of lead l_3 must not exceed 25mm^2 . (See figure below).

If possible the sum of R_0 , R_1 , R_2 and R_3 should be smaller than the R_{XG} requires.

With higher internal mains resistances the generator output is reduced correspondingly.



R_0 designates the mains resistance of the distributor transformer

R_1 depends on the length of lead l_1 between distributor transformer and mains distributor and on the selected cross section as well:

$$\Rightarrow R_1 = l_1 \times R_{Cu} \quad R_{Cu} \text{ from table below}$$

R_2 consists of upstream elements such as:

- Emergency-OFF switch $4.0\text{m}\Omega$
- Earth-leakage circuit breaker $5.5\text{m}\Omega$
- Fuse $5.5\text{m}\Omega$
- Surge arrester WN $23.0\text{m}\Omega$

R_3 depends on the length of lead l_3 between mains distributor and wall junction box and on the selected cross section as well:

$$\Rightarrow R_3 = l_3 \times R_{Cu} \quad R_{Cu} \text{ from table below}$$

The resistances consider the go and return lines so that the calculation can be based on simple cable lengths.

Copper cross section [mm ²]	Resistance R_{Cu} [mΩ/m]
16	2.19
25	1.4
35	1.0
50	0.7
70	0.5
95	0.38
120	0.30
150	0.24

Note

$500\text{m}\Omega$ is the **absolute max.** mains resistance.

5.4.3. Earth-leakage circuit breaker

To be provided between mains fuse and X-ray installation depending on local regulations.

Siemens earth-leakage circuit breaker:

- Order No.: 5SZ3 466 OKG00
- Rated fault current 30mA
- Rated current 63A
- Connection terminals for wire cross sections of up to 25mm²

5.4.4. Emergency-OFF device

To be provided depending on local regulations.

There are 2 possibilities:

1. All the emergency-OFF buttons are connected in series and looped into the switch-ON circuit (12VDC) of the generator.
2. The emergency-OFF circuit acts on an external mains contactor which switches OFF the power before it is fed into the generator.

6. Tools

- Service engineer standard tool kit
- Service-PC:
IBM-compatible, 640kB RAM, 3.5" floppy disk drive, ≥ 1 serial port
- Installation and service software OMC: 4512 116 024xx.
Supplied on a floppy disk within this generator service manual.
- PC-hardkey (DIAGGEN):
Necessary to carry out the installation and to run the service software (special programmings, fault finding).
- 0-modem cable:
Minimum length is distance between generator cabinet and operating desk.
Male 25-pole D-Sub connector at the generator side.
A 5m data cable of bucky controller can be used: 4512 130 5693x
- Mains resistance measuring instrument
- Dose measuring instrument
- mAs-meter
- Multimeter
- Digital oscilloscope with 2-beam memory
- Recommended PLCC extraction tool (AMP 822154-1): 2422 487 89772

7. Traceable items

The following items have serial numbers of the following format when delivered ex factory:

1. Generator cabinet 6 digit serial number
2. H.V. tank 7 digit serial number

8. Preparation

- Connection of the generator: see drawing Z-6.1
 Connection of the generator with PDU: see drawing Z-6.2
 Operating panel: see drawing Z-1.3
 Connection diagram: see drawing Z-7.1/.2
 Earthing diagram: see drawing Z-7.3
 Legend for earthing and cabling: see drawing Z-7.10

8.1. Installation material

To be ordered from the service department of PMS Hamburg:

- Wall junction box 4512 103 7538x
 inclusive connection block (25mm²) for mains supply and connection block (10mm²) for unit supply.
- Relay for radiation warning indicator 4512 100 4523x
 1 interface relay with a floating contact (230V/1A) is included in the scope of delivery of the generator.

8.2. Cables

H.V. cables

- with O3 / O3 plugs: 9806 402 6xx02
 length: 6m – 30m in steps of 2m
 capacity: 155pF/m
 diameter: 16.5mm

The cable length is indicated by the 9th and 10th digit of the numeric code.

Thermal contact cable

- 3-wire screened for 1 excess temperature switch 4512 100 66162
 (3 x 0,5mm², Ø 5,3mm)
- 10-wire screened for additional supervision like
 temperature alarm switch, buzzer, selection indicator 0722 215 19005

Stator cable

- Tube SRM-0612 : 3x 1,31 mm², screened with uMNL-connector 3322 405 14191
- all other tubes :
 3 x 1.31mm², screened 0722 215 02054

AMPLIMAT cable

with D-Sub and 3-Plus plug:

- 12m 9890 000 01721
 16m 9890 000 01731
 20m 9890 000 01741
 24m 9890 000 01751

Note

The above described cables are part of the pre-assembled systems.

8.3. Manpower

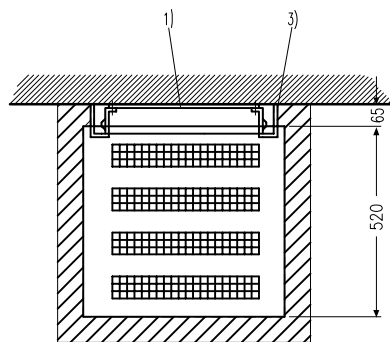
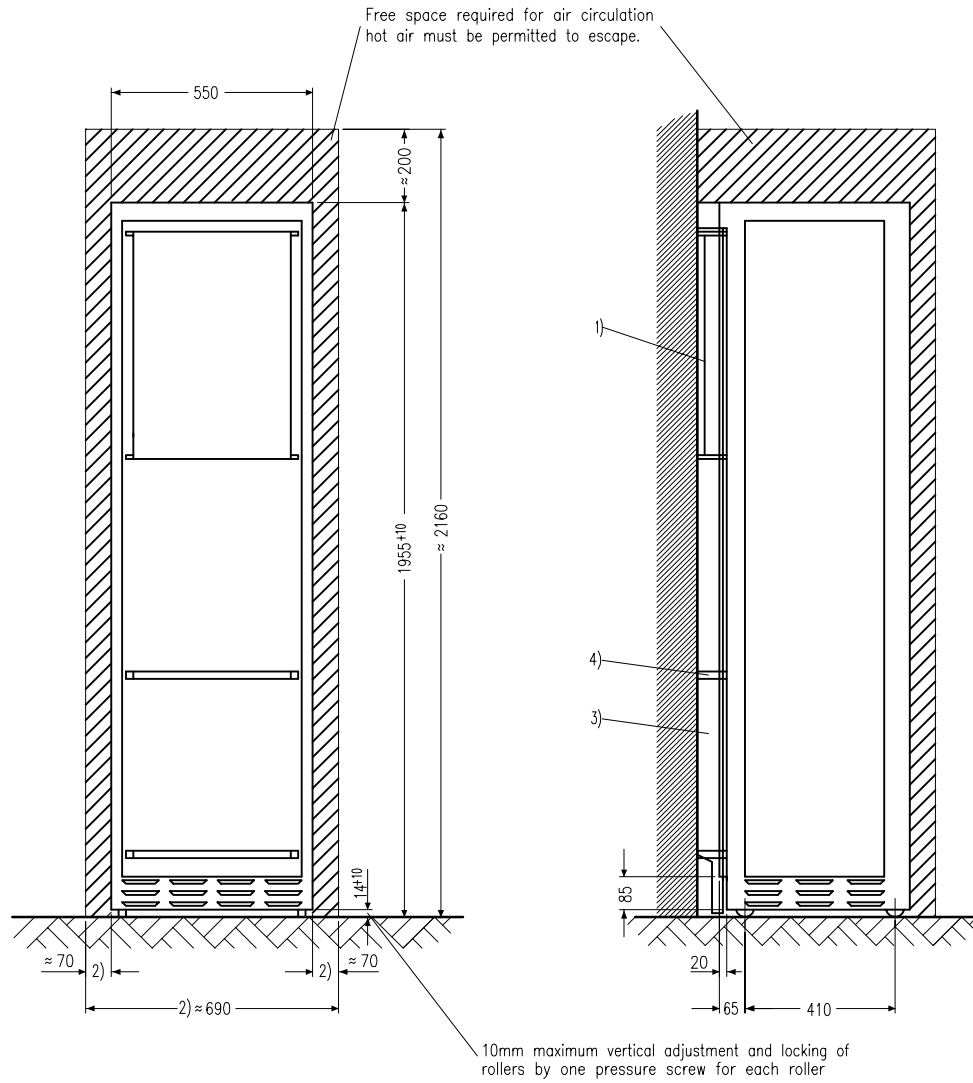
At least two persons are necessary to insert the H.V. tank in the generator cabinet.
The weight is about 73kg.

9. Planned maintenance

The technical documentation for carrying out maintenance work in compliance with the applicable regulations are available at the responsible authority of Philips Medical Systems.

The importance of having maintenance implemented is pointed out to the operator in the operating instructions.

It must be guaranteed that the person carrying out maintenance work knows about the respective national regulations and that this person observes these regulations throughout all steps of maintenance work.



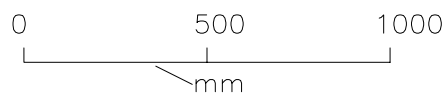
1) Wall junction box

2) Lateral clearance unless there is an adjacent cabinet

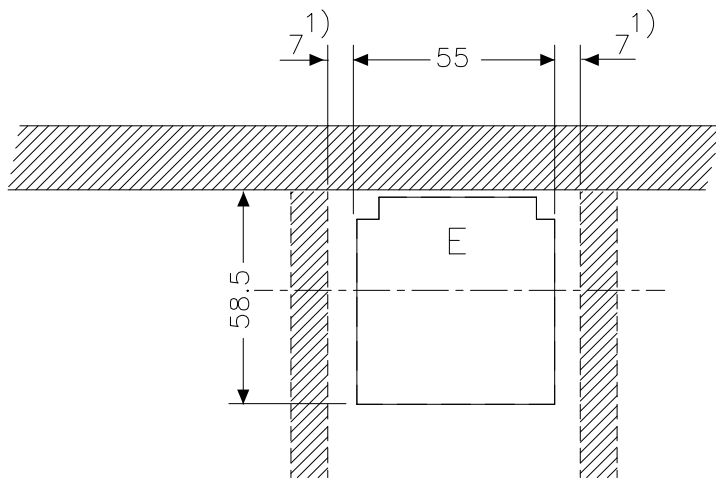
3) Filler panel

4) Wall-cabinet spacing angle

weight : 210 kg



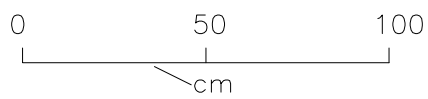
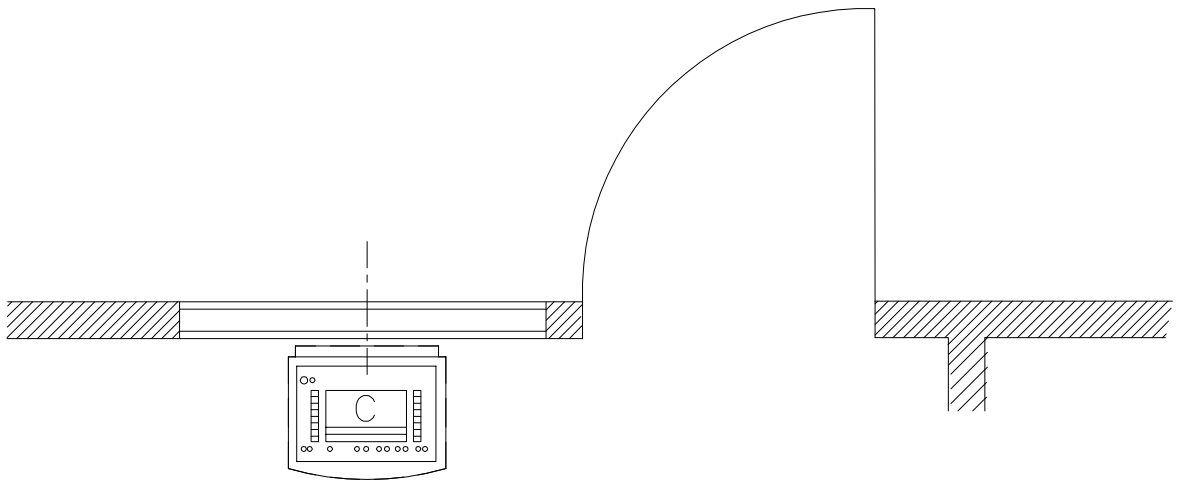
Generator Cabinet Mechanical dimensions



1) With no other cabinets beside them

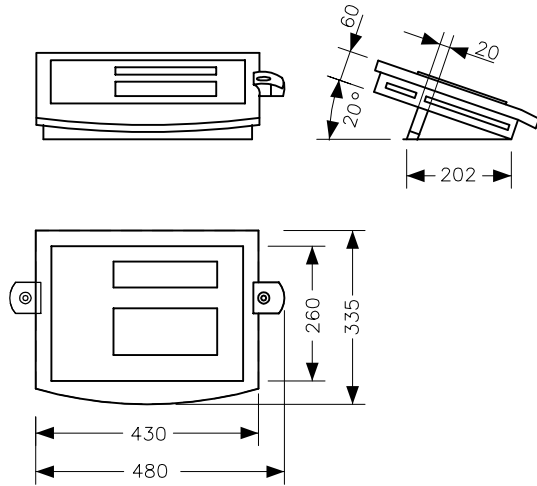
E= Control cabinet

C= Operating desk



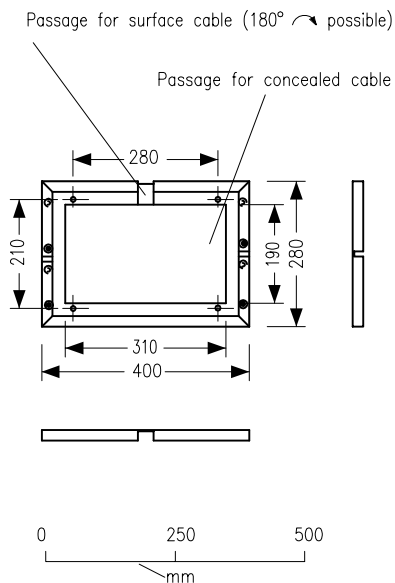
OPTIMUS C
Overlayer for room layout

① Low profile control desk

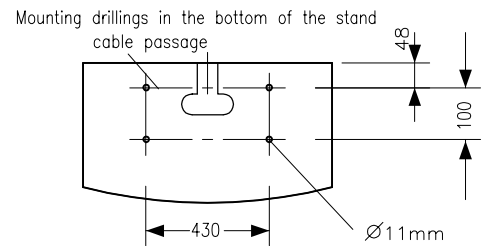
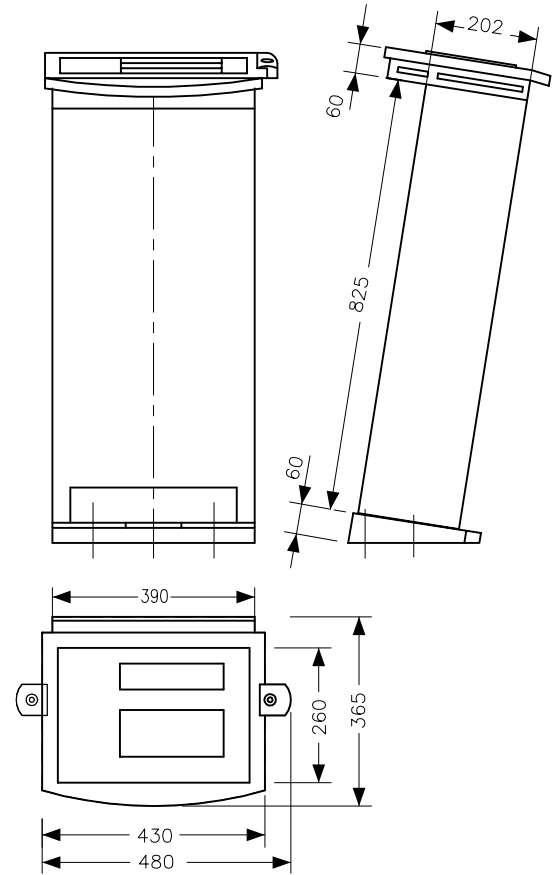


Note:
In this drawing the control desk is shown.
The dimensions are also valid for cockpit CB.

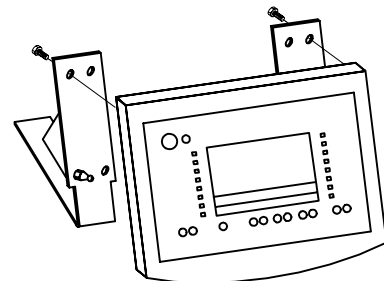
③ Wall-mounting support



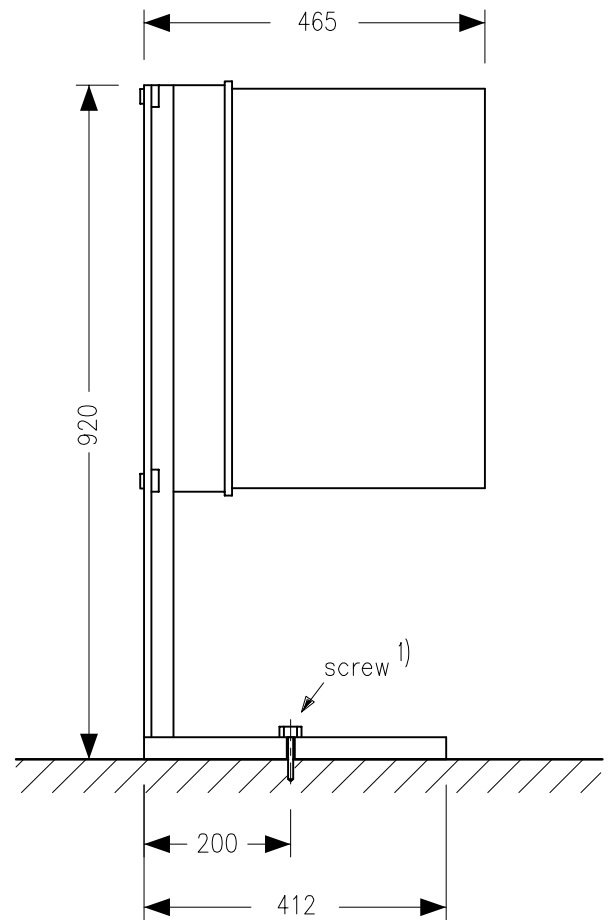
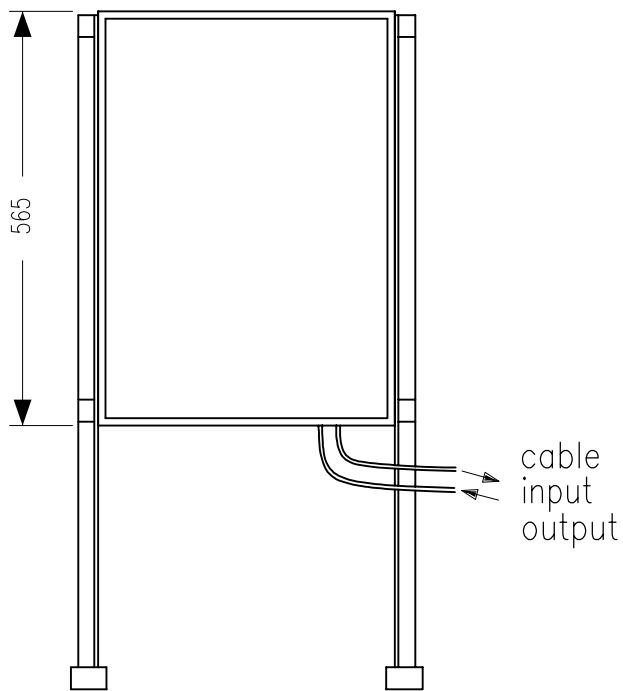
② Stand for low profile control desks



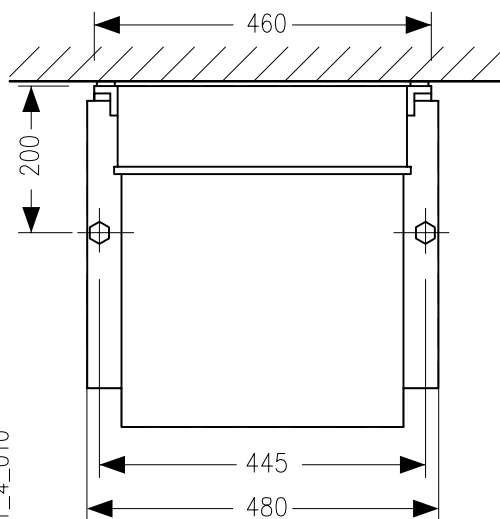
④ User interface support (not possible for digital DIAGNOST)



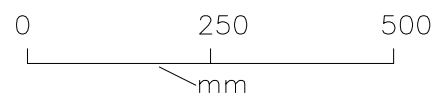
Operating panel
Mechanical dimensions



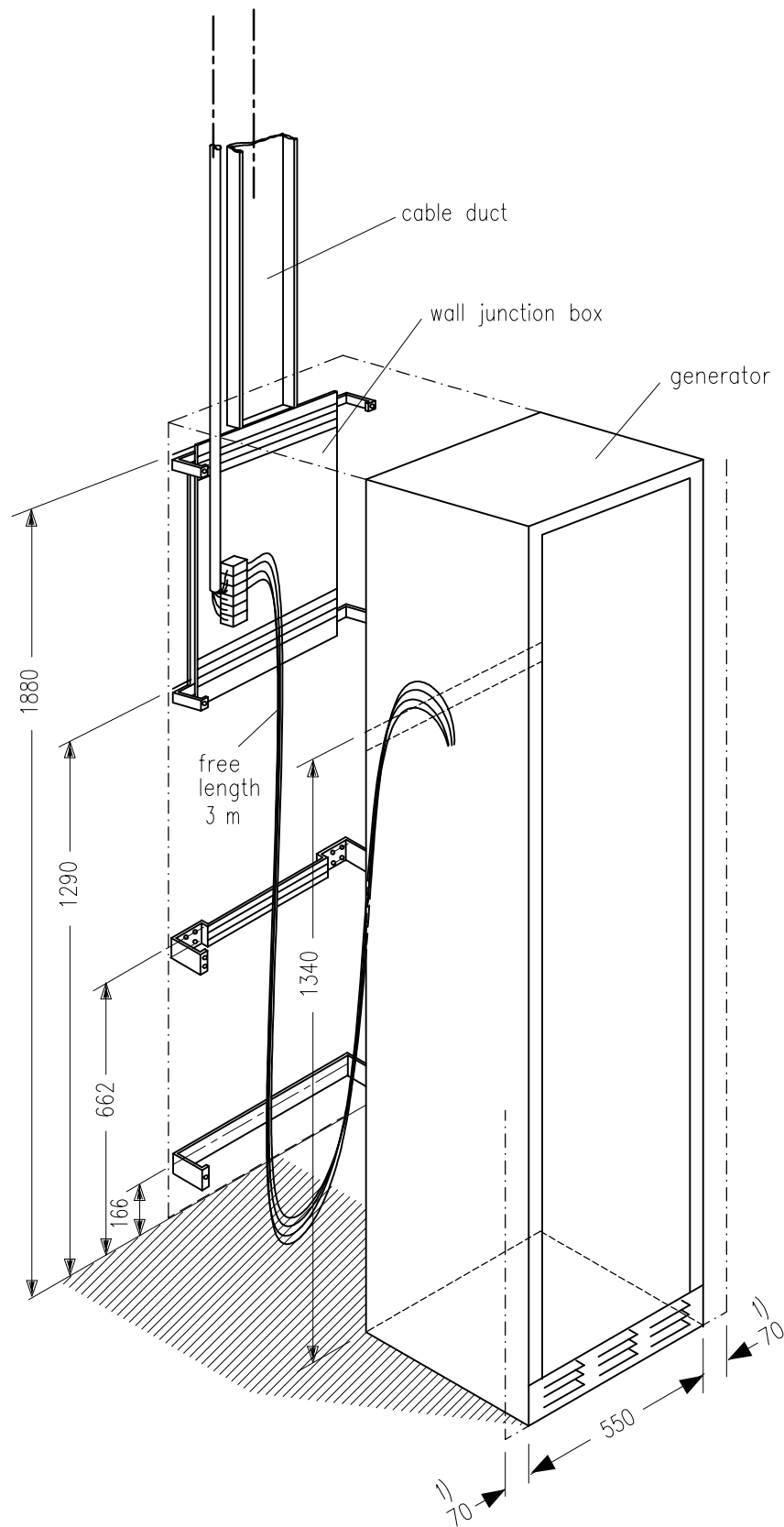
1) Screw connection (screws 7 x 60, dowels 8)
only when requested. It is actually not needed



Weight 100 kg

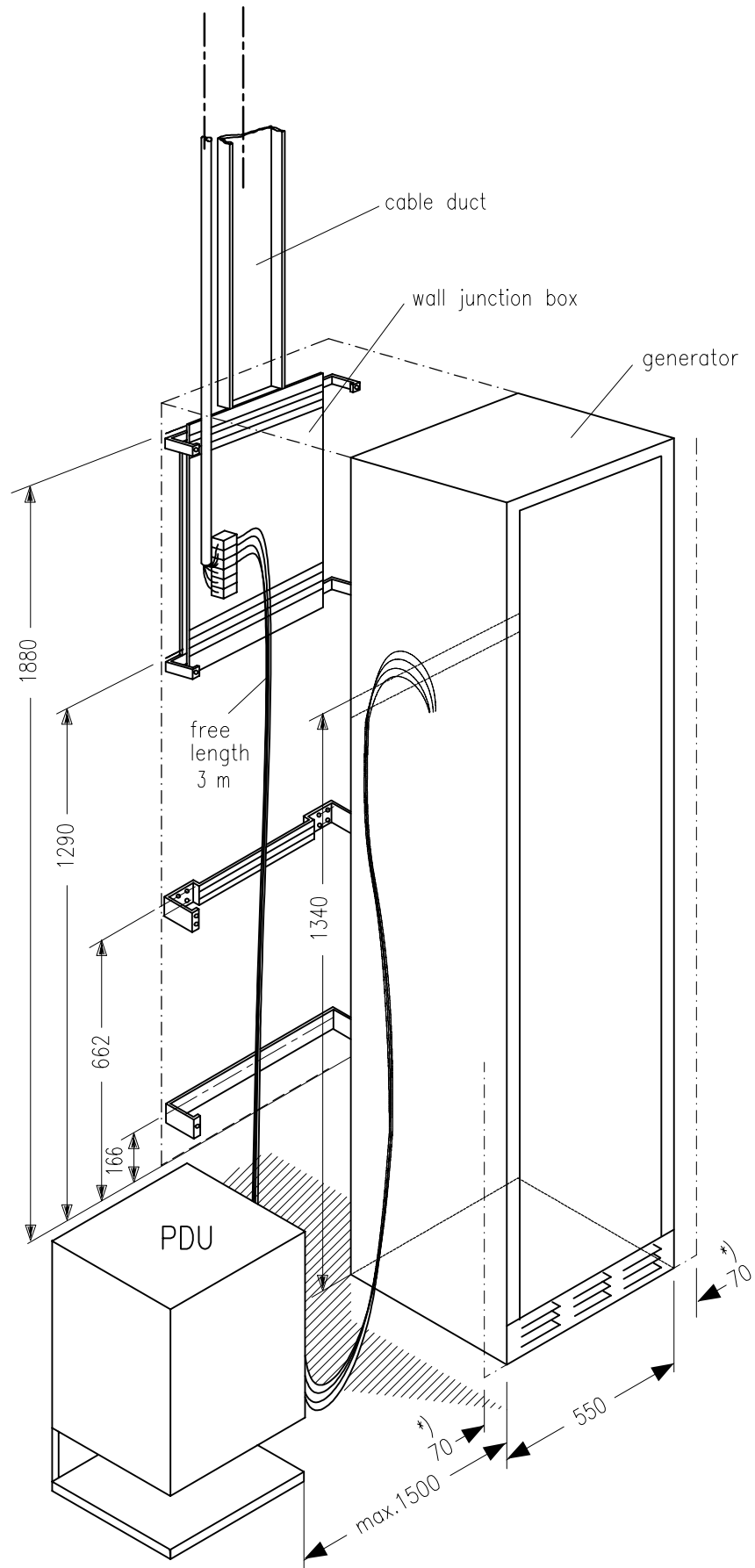


Power distribution unit (PDU)
9890 000 0260x
Dimensions and weight



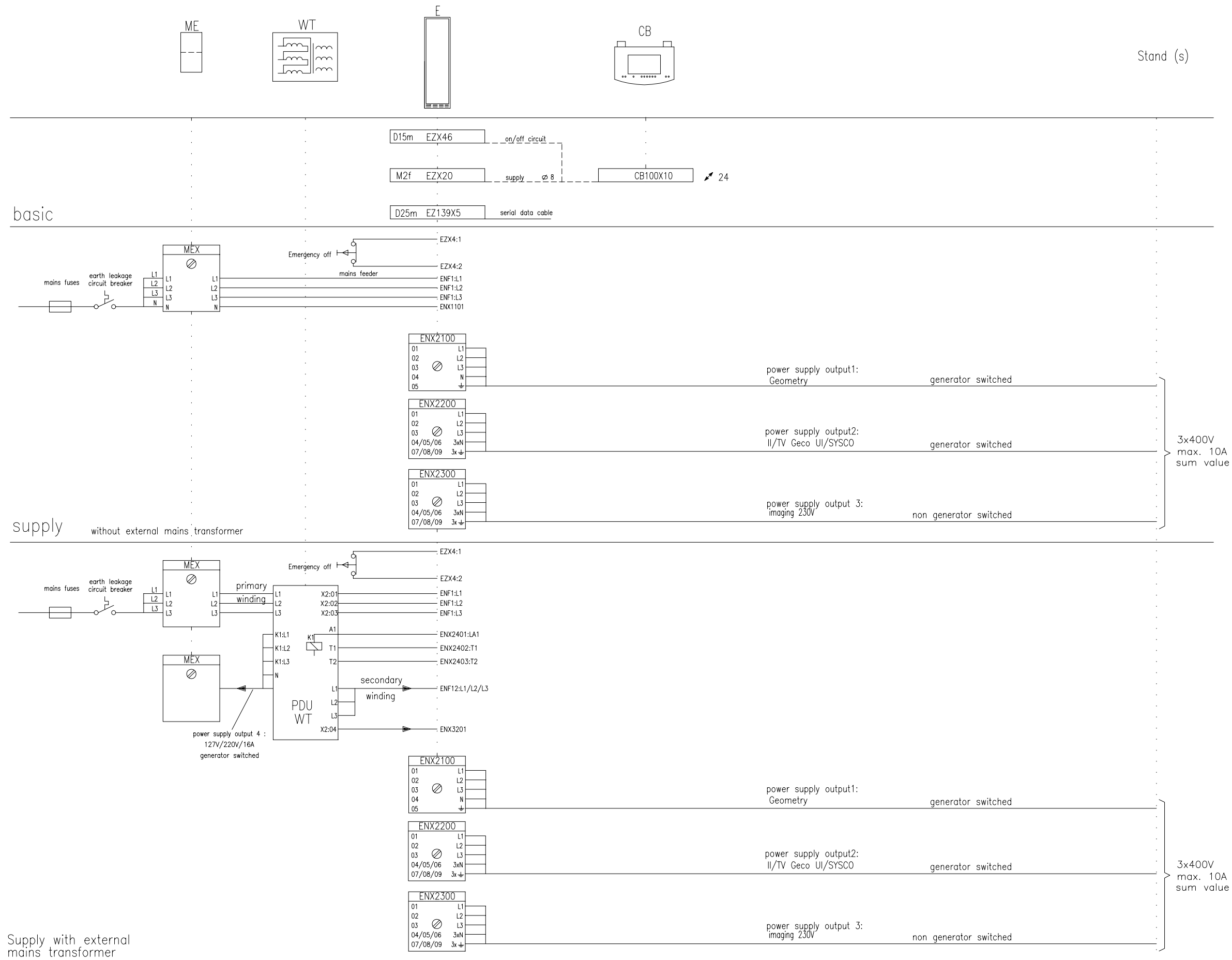
1) Space with no other cabinets beside them.

Connection of generator



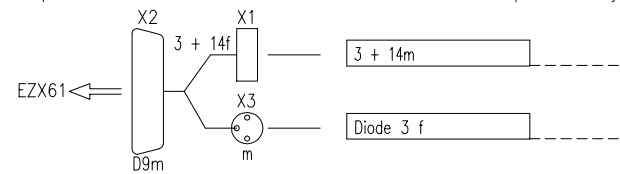
*) Space with no other cabinets beside them.

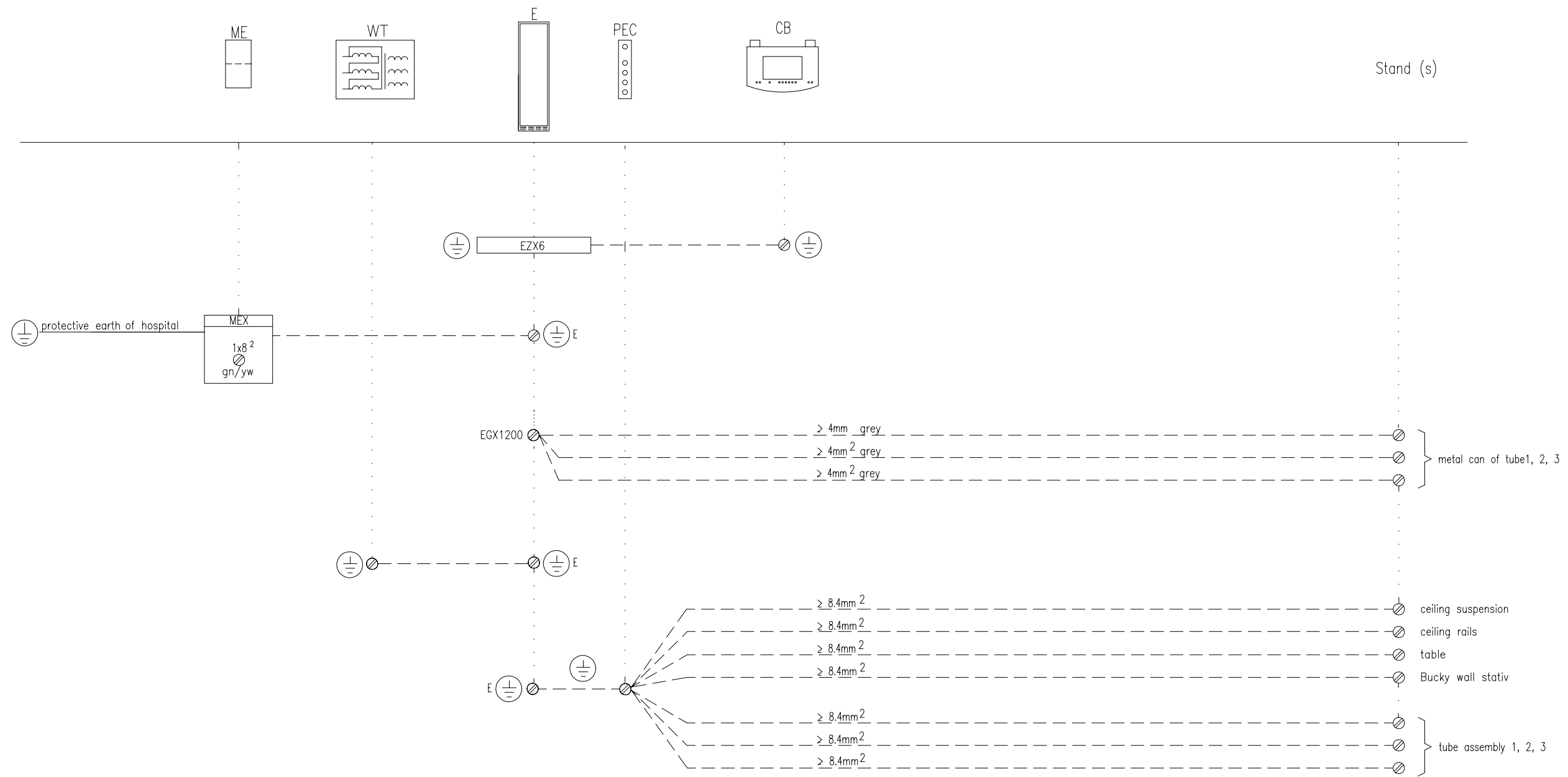
Connection of generator
with Power Distribution Unit (PDU)



Supply with external
mains transformer

OPTIMUS C
Connection diagram

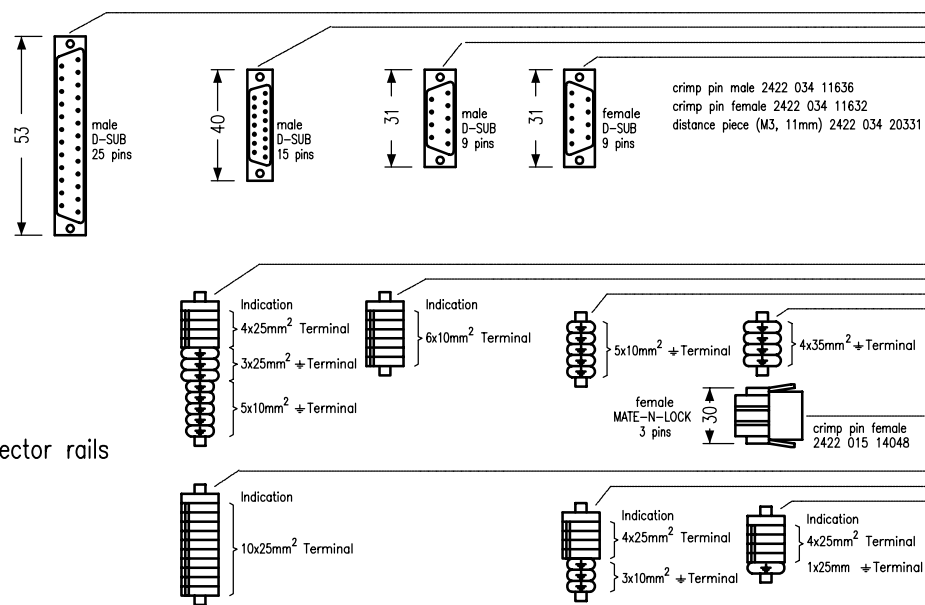
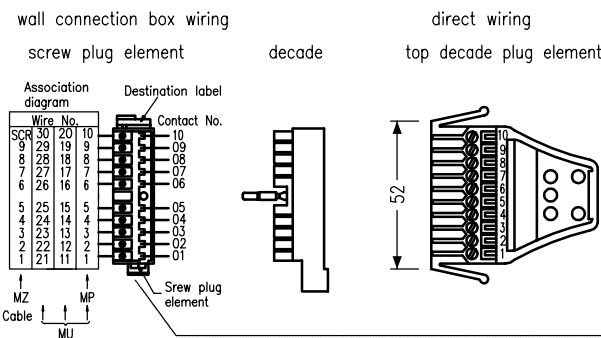




- Connection plugs

- Connector rails

- Connection plugs



Description	Data		
M (4 x 0.75 mm ²) N (7 x 1.5 mm ²) Q (18 x 1 mm ²) R (25 x 1 mm ²)	ø8.0 ø13.5 ø19.0 ø21.2	0712 164 01002 0712 163 03001 0712 163 00001 0712 164 10003	xx metre xx metre xx metre xx metre
MJ (34 x 1 mm ²) MP (12 x 1.5 mm ²) MT ((4 + 1) x 10 mm ²) MT ((4 + 1) x 16 mm ²) MT ((4 + 1) x 25 mm ²) MM (5 x 2.5 mm ²) MY ((6 + 1) x 0.5 mm ² screened) MZ (9 x 0.82 mm ² screened) MW (2 x 0.82 mm ²) da (3+1 x 1.38 mm ²) db (3 x 1.3 mm ² screened + yield) (AWG 16) dc (2 x 0.8 mm ²) dd (5 x 2 x 0.22 mm ² screened) de (12 x 2 x 0.22 mm ² screened) df (10 x 0.5 mm ²) dg (10 x 0.5 mm ² screened) dh (8 x 2 x 0.22 mm ² screened + yield) dx (10 x 0.5 mm ² mushroom) dy (2 x 0.5 mm ² mushroom , screened) dz (10 x 0.5 mm ² mushroom , screened)	ø21.1 ø14.1 ø20.5 ø24.5 ø31.0 ø14.3 ø9.3 ø15.6 ø6.7 ø8.0 ø9.2 ø6.2 ø7.4 (twisted pair) ø9.6 (twisted pair) ø7.3 ø7.8 ø8.4 (twisted pair) ø9.0 ø5.3 ø1.0	4512 152 31061 4522 100 85001 4512 152 31201 4512 152 31161 4512 152 31181 0722 207 04022 0722 212 02003 0722 215 16002 0722 300 01004 0722 207 03044 0722 215 02054 0722 300 01011 0722 215 62001 0722 215 51007 4512 100 66451 0722 997 07248 0722 215 33008 0722 276 05003 4512 100 66151 0722 215 19009	xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre xx metre
(5 + 2) x 0.85 mm ² stator cable 4 x 5.2 mm ² stator SRC 1 x 4 mm ² grey (AWG 12) 2 x 0.75 mm ² screened 3 x 0.2 mm ² screened	ø11.5 ø16.6 ø5.4 ø6.5 ø6.0	0722 464 02003 0722 186 00536 0712 187 00002 0722 223 00002	xx metre xx metre xx metre xx metre xx metre
1 x 25 mm ² PE 1 x 16 mm ² PE 1 x 8.4 mm ² FE/PE (AWG 8) 1 x 6 mm ² PE 1 x 4 mm ² PE 1 x 16.7 mm ² PE 1 x 8.25 mm ² PE	ø9.0 ø7.6 ø9.3 ø6.82	4512 152 31141 4512 152 31121 0722 186 00503 4512 152 31241 0722 186 00095 4512 100 66131 0722 186 00601	xx metre xx metre xx metre xx metre xx metre xx metre xx metre
8 m 12 m 8 mm – measuring chamber cable 16 m 20 m 24 m 28 m		XC 5070 /08 XC 5070 /12 XC 5070 /16 XC 5070 /20 XC 5070 /24 XC 5070 /28	
H.V. (03 – 03, 150 kV)	ø16.5	9806 402 6xx02	(xx = length in m)

Orderinglist

Codenummer	quantity
2422 025 04936	10 pieces
4512 126 25243	10 pieces
2422 025 05039	1 piece
2422 025 05038	1 piece
2422 025 05456	1 piece
2422 034 18334	1 piece
4522 980 38051	1 piece
4522 980 18141	1 piece
4512 152 55244	1 piece
4522 980 38031	1 piece
2422 025 02991	1 piece
4522 980 18041	1 piece
4512 152 56761	1 piece
4522 980 18081	1 piece
0712 164 01002	xx metre
0712 163 03001	xx metre
0712 163 00001	xx metre
0712 164 10003	xx metre
4512 152 31061	xx metre
4522 100 85001	xx metre
4512 152 31201	xx metre
4512 152 31161	xx metre
4512 152 31181	xx metre
0722 207 04022	xx metre
0722 212 02003	xx metre
0722 215 16002	xx metre
0722 300 01004	xx metre
0722 207 03044	xx metre
0722 215 02054	xx metre
0722 300 01011	xx metre
0722 215 62001	xx metre
0722 215 51007	xx metre
4512 100 66451	xx metre
0722 997 07248	xx metre
0722 215 33008	xx metre
0722 276 05003	xx metre
4512 100 66151	xx metre
0722 215 19009	xx metre
0722 464 02003	xx metre
0722 186 00536	xx metre
0712 187 00002	xx metre
0722 223 00002	xx metre
4512 152 31141	xx metre
4512 152 31121	xx metre
0722 186 00503	xx metre
4512 152 31241	xx metre
0722 186 00095	xx metre
4512 100 66131	xx metre
0722 186 00601	xx metre
XC 5070 /08	
XC 5070 /12	
XC 5070 /16	
XC 5070 /20	
XC 5070 /24	
XC 5070 /28	
9806 402 6xx02	(xx = length in m)

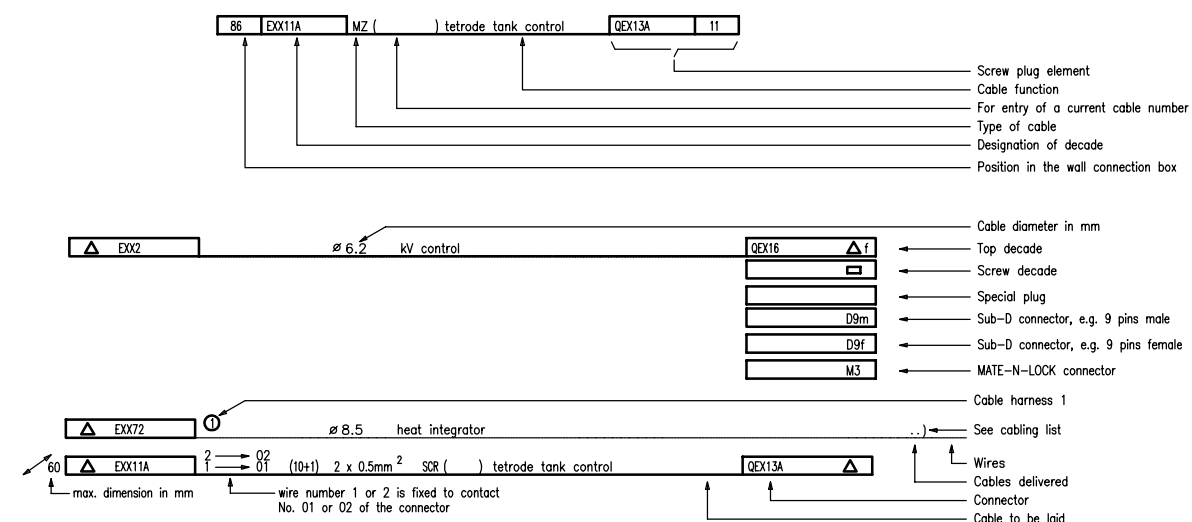
- Heading symbols

A	electronics cabinet angio
BL	electronics cabinet DSI
C	operators console
E	electronics cabinet X-ray generator
G	high tension tank frontal
GW	H.V. changerover switch
HCU	hard copy unit
K	electronics cabinet TOMO
LHCU	laser hard copy unit
MC	wcb operators console
ME	wcb electronics cabinet X-ray generator
MK	electronics cabinet TOMO
MON	monitor
MR	wcb electronics cabinet
MT	connection box wall bracket
MU	overhead connection box ceiling crane
R	electronics cabinet
S	bucket table
UB	ceiling crane
UT	ceiling crane longitudinal carriage
UZ	wall bracket
V	ceiling crane
vD	vertical DIAGNOST 1 1/2/4
vD	bucket DIAGNOST VE/NT
VP	wcb bucket DIAGNOST
wcb	wall connection box

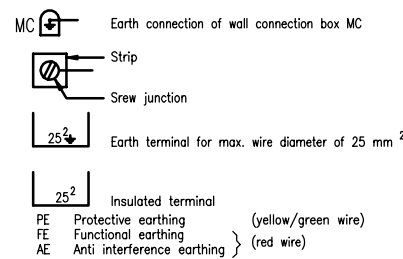
- X-ray beam symbols

BB	image intensifier
BD	image distributor
BK	II camera
LA	collimator
SA	film plane
WK	TV camera
XA	X-ray tube

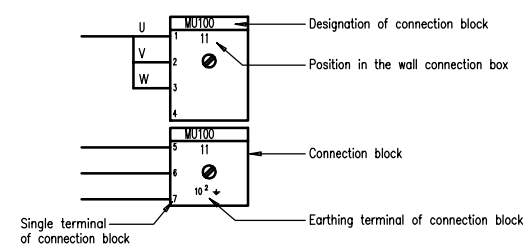
- Cable symbols



- Earthing



- Connection blocks



Legend for earthing
and cabling diagram

INSTALLATION

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DRAWINGS

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1. Installing the wall junction box

- Mount the wall junction box at the place where the generator is intended to be installed.
(See drawing “Connection of generator” in section 1 and manual UNIT 4512 103 75380 for wall junction boxes).
- If necessary, install the optional surge arrester WN inside the wall junction box.
(See surge arrester documentation.)
- If applicable, mount the filler panels of the generator to the wall junction box.
- Have the mains cable present at the clinic connected to mains terminal MEX by a person who is authorized for this job.
- Check the phase sequence of L1, L2 and L3.



Warning!

Switch OFF the mains supply present at the clinic and make sure that it cannot be switched ON again accidentally.

2. Mounting the H.V. generator in the cabinet

2.1. Mounting of the H.V. generator in the cabinet

Caution!

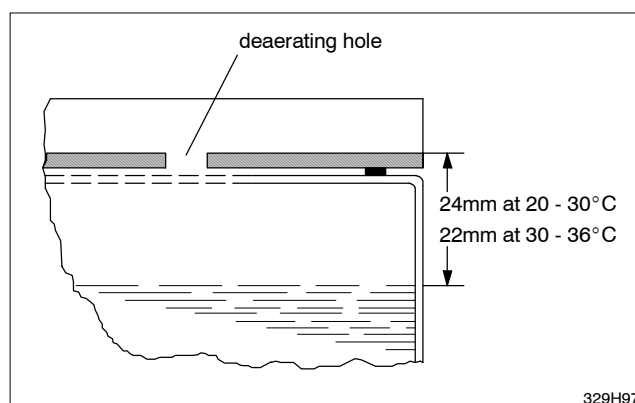
Do not tilt the H.V. generator while transporting it.

In case of a tilting angle larger than 45°, the setting-to-work of the generator can be started not before a waiting time of about 8 hours has passed. Otherwise the H.V. generator may be destroyed by electrical sparkover.

- Unpack generator cabinet E.
- In case the packing material is strongly soiled with oil check the oil level. Repair it if necessary.

Tolerance: $\pm 2\text{mm}$

Oil: Shell Diala G in 2.5l container
4512 148 43172



329H97

- Remove the deaerating screw completely from the cover of the H.V. generator. Only this way the precision of the high voltage measuring divider corresponds to the specification.
In case of return shipment of the H.V. generator this screw must be fixed again. Therefore, keep the screw laying on top of the cover.

Caution!

Make sure that no foreign matter falls into the oil. Otherwise the transformer must be exchanged.

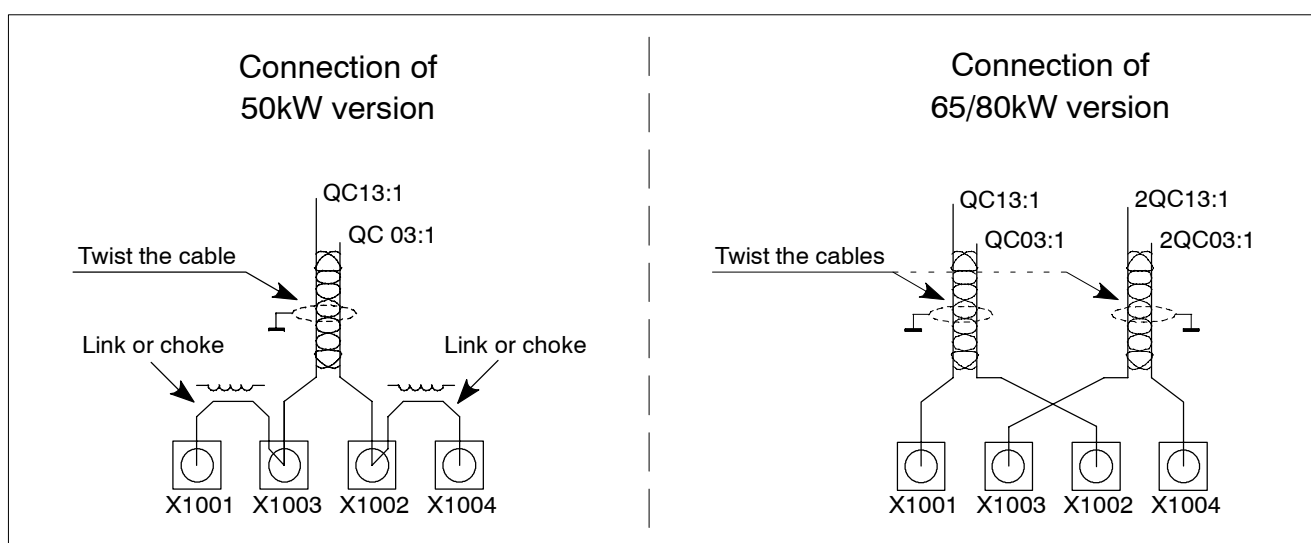
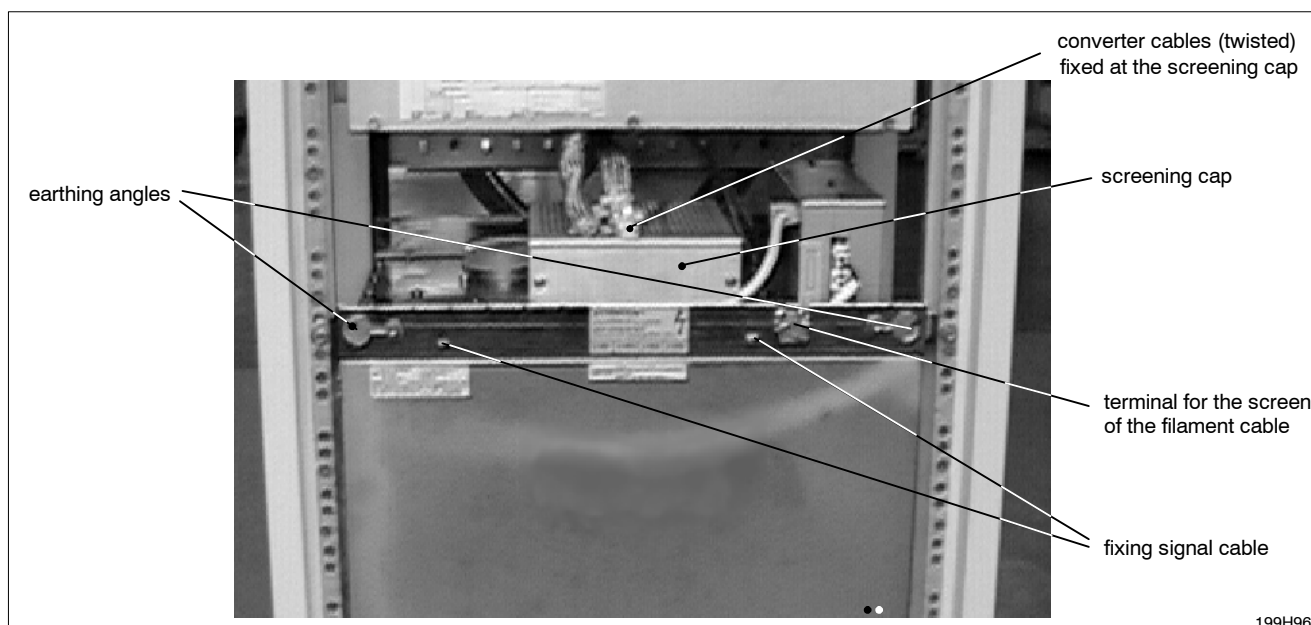
- Take the two transport bars from the rear side of the cabinet.
- Lift the H.V. generator into the generator cabinet with the transport bars.
The 4 connecting bolts GX1001 to 1004 must point at the front of the generator cabinet.

2.2. Electrical connection of the H.V. generator

- Connect the H.V. generator electrically:

Generator version	Connection			Remark
	from	<---->	to	
50/65/80kW	E1 (GND)	<---->	GX1100 (GND)	Ground
	ZX12	<---->	G100X15	Route the cables along the front and left-hand edge of the H.V. generator. Fix them.
	ZX35	<---->	G100X14	
50kW	QC13:1	<---->	GX1003	Twist the cables! Note <i>The sequence of the connecting bolts is not in numerical order. See drawing page 2-4.</i>
	QC03:1	<---->	GX1002	Push the screening cap forward over the connecting bolts and tighten it. Attach the converter cables including the screening to the screening cap with cable ties.
	GX1001	<---->	GX1003	The 50kW version might have direct links on each side or a link on one side and a choke of 1 ... 6 loops on the other side for the reason of kV symmetry.
	GX1004	<---->	GX1002	Note <i>Do not change these links or chokes.</i>
65/80kW	QC13:1	<---->	GX1001	Twist the cables! Note <i>The sequence of the connecting bolts is not in numerical order. See drawing page 2-4.</i>
	QC03:1	<---->	GX1002	Push the screening cap forward over the connecting bolts and tighten it. Attach the converter cables including the screening to the screening cap with cable ties.
	2QC13:1	<---->	GX1003	
	2QC03:1	<---->	GX1004	

- Turn the two earthing angles of the H.V. generator outward and screw them on to the members of the cabinet.



3. Installing the operating panel

See Unit Manual COCKPIT for DuoDiagnost.

4. Electrical connection

4.1. Earthing

See "Earthing diagram" in section 1.

4.2. Mains connection

4.2.1. Mains connection of the generator



Warning!

Switch OFF the mains supply present at the clinic and make sure that it cannot be switched ON again accidentally.

See "Connection diagram" in section 1.

- Measure the internal mains resistance at the terminal MEX with a suitable measuring instrument.

L1 - L2: $R_i = \dots\dots\dots \text{m}\Omega$

L1 - L3: $R_i = \dots\dots\dots \text{m}\Omega$

L2 - L3: $R_i = \dots\dots\dots \text{m}\Omega$

Required max. mains resistance at generator input:

Mains voltage	Mains resistance		
	30kW	50kW	65/80kW
190V *	–	40m Ω	–
220V *	130m Ω	60m Ω	–
240V *	160m Ω	80m Ω	–
380V	500m Ω	300m Ω	200m Ω
400V	500m Ω	300m Ω	200m Ω
440V	500m Ω	350m Ω	240m Ω
460V	500m Ω	350m Ω	240m Ω
480V	500m Ω	400m Ω	300m Ω

* with external mains transformer (max 50kW)

Maximum permissible internal mains resistance: 500m Ω

Internal resistance of Power Distribution Unit PDU: 20m Ω at 50Hz
23m Ω at 60Hz

Caution!**Connect phase wires in correct phase sequence.**

- Connect the mains cable of the generator to terminal MEX: L1 / L2 / L3 within the wall connection box.
If the optional **P**ower **D**istribution **U**nit **PDU** WT is fitted, connect the cables at that point to terminal WTX2.
- Connect the examination unit supply (max. 10A) to (230V / 400V):

Output 1	Geometry power	ENX2101/...5
Output 2	I.I. / TV; GECO; UI; SYSCO	ENX2201/...9
Output 3	Imaging (Output 3 not switched by generator)	ENX2301/...9

4.2.2. Mains connection of the PDU

See delivered Unit Manual "Power Distribution Unit".

4.3. Stator connection

4.3.1. Shielding

Caution!

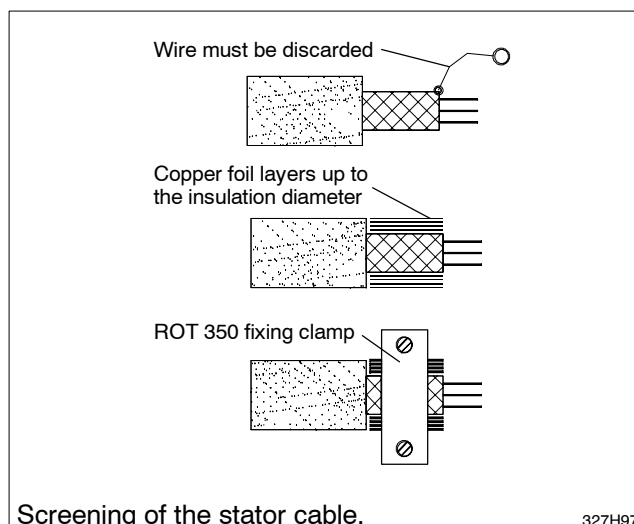
To suppress interferences of the high-speed rotor control, the stator connections must be provided with a 360° screen at the tube and generator end.

General remarks:

- SRM-0612 : 3322 405 14191
- all othes tubes :
- Always use screened cables: 0722 215 02054.
- Shorten the stator cable to the required length. Do not accommodate excess lengths at the generator.
- Keep stator cable separate from all the other signal cables to avoid interference.
- Earth the screen at both cable ends.

Screening procedure:

- Remove any enamel or dirt from the clamp providing drag relief in the tube housing to make sure the clamp is conductive.
- Remove the plastic covering around the clamp, about 1cm (0.5").
- Wrap copper foil around the visible screen of the cable until the original diameter of the cable is obtained.
- Remove the present red wire going from the screen end to the earthing point of the tube housing.
- Fix the screen of the stator cable with the clamp. Ensure that the clamp is secured and the ground contact works!



4.3.2. Connection

Caution!

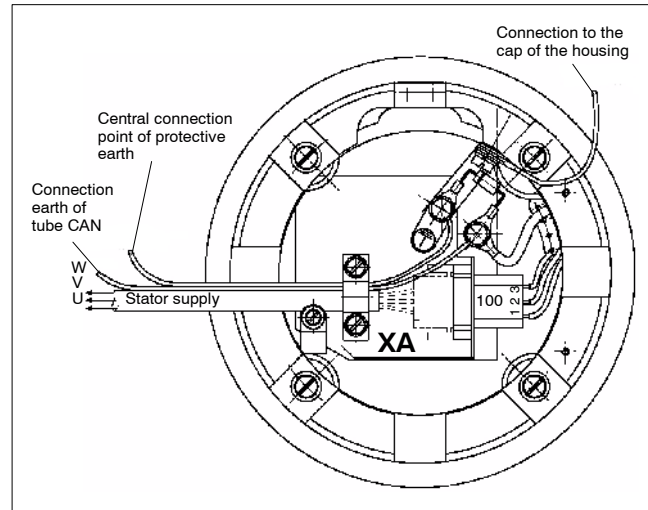
Do not mix up the phases, otherwise components of the rotor control may be destroyed.

At the tube end - only SRM-0612

Note

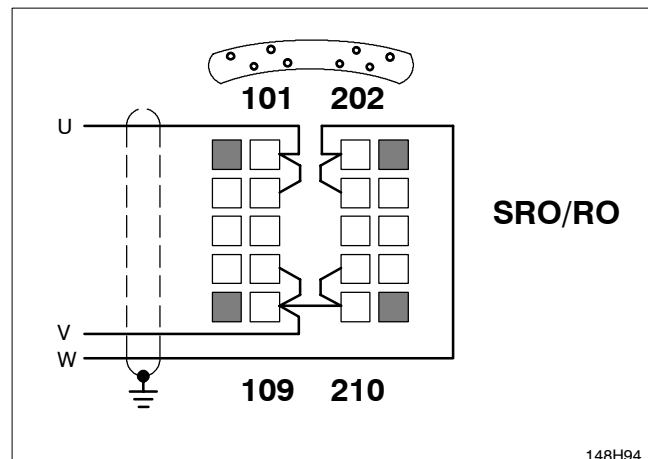
The following steps are valid for SRM 0612 tubes only.

- Connect the stator cable with the MATE-N-LOCK connector.
- Connect protective earth and earth of tube CAN as shown in figure beside.
- Earth the screening of the stator cable at the tube housing with the metallic clamp.



At the tube end - all other tubes

- Place the jumpers across terminals 100 and 200 according to the figure.



- Connect the stator cable:
 - wire 1 ---> phase U
 - wire 2 ---> phase V
 - wire 3 ---> phase W
- Earth the screening of the stator cable at the tube housing with the metallic clamp.

At the generator end

See "Connection diagram" in section 1.

- Connect the stator cable to the terminal EX1100 (U-V-W).

- Check the stator connection by measuring the resistances:

$$U - V = \text{wire 1 - 2} \approx 11\Omega$$

$$U - W = \text{wire 1 - 3} \approx 20\Omega$$

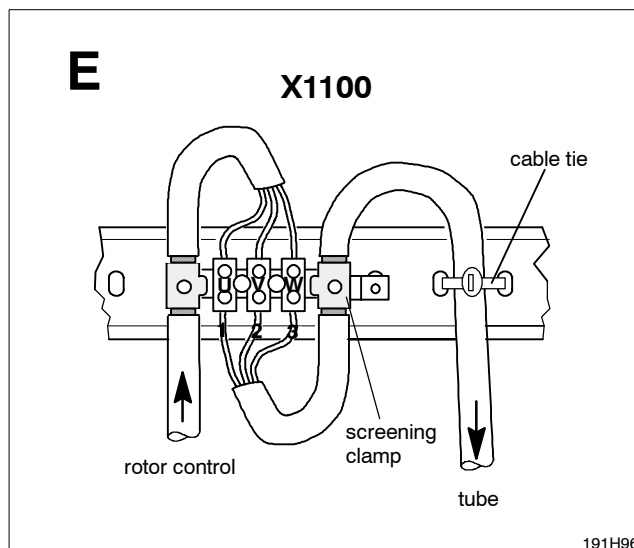
$$V - W = \text{wire 2 - 3} \approx 9\Omega$$

- If an inductance meter is available, measure the following inductance values:

$$U - V = \text{wire 1 - 2} = 57\text{mH} \pm 10\%$$

$$V - W = \text{wire 2 - 3} = 34\text{mH} \pm 10\%$$

- Fix the screen below the screening clamp.
- Relieve the tension of the stator cable by a cable tie.



191H96

4.4. Signal cables

See: - "Connection diagram" in section 1.
- Z1-6 "Basic interface" in section "Schematic drawings"

4.4.1. Room decade cable

- Connect the door switches at the generator:

EZX1: 8 <---> switch <---> 10

or

EWBX22: 8 <---> switch <---> 10

In case no switch is present

link: pin 8 <---> pin 10

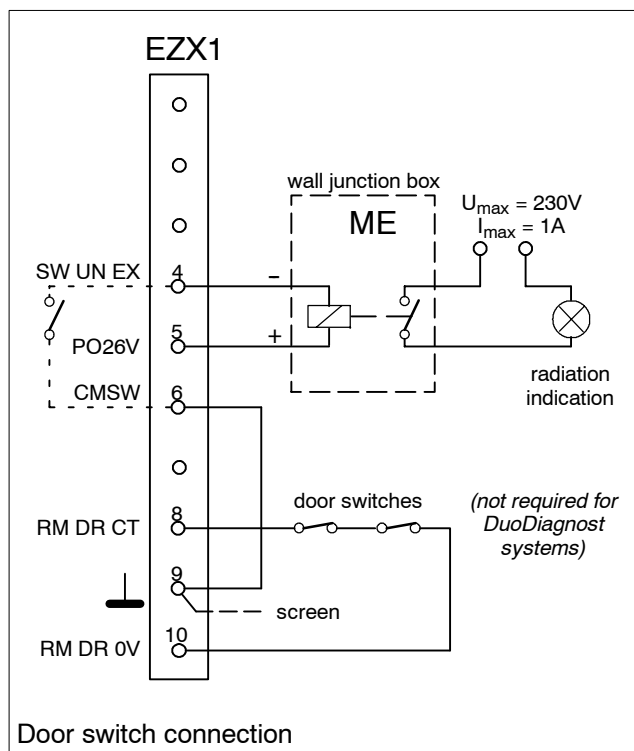
EZ150 K1:

max. switching and loading current = 1A

max. Load = 60VA AC
= 30W DC

Caution!

Make sure the polarity of the relay is correct.

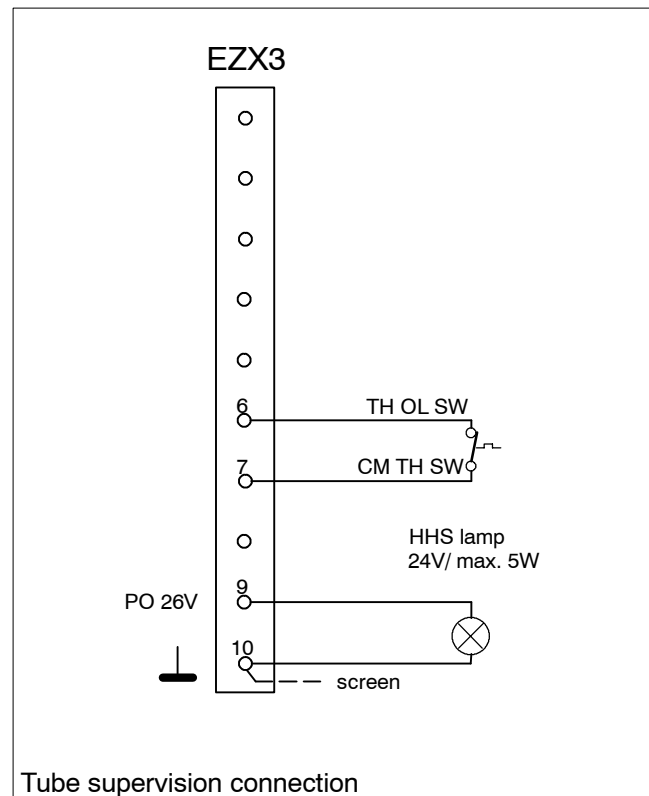


4.4.2. Tube supervision

- Connect the thermal switch or the thermal sensor of the tube housing assembly.

For U.S.A. and U.K. only:

- Connect the HHS-lamp to indicate the selected tube housing assembly.



4.4.3. CAN interface

- For examination units which are provided with a CAN system interface connect:
 - EZX 23 - signalbus
 - EZX 43 - system CAN

4.4.4. Dose input

- Connect the measuring chambers to the D-Sub connectors EZX21/22. EZX31/32/41 are not used.

Note

There are restrictions on assignment because the measuring chambers are assigned to certain auxiliaries in SW programming of COCKPIT.

4.4.5. Dose rate input

- Connect the dose rate output of TV chain for fluoroscopy at EZX61. Use the I.I./TV adapter on EZX61. See also drawing Z1-5.1 "Central unit".

4.5. H.V. cables generator side

See "Connection diagram" in section 1.

- Mark the H.V. cables at the generator and the tube end with the correct polarity.
- Fix the H.V. cables on the left-hand side of the wall junction box on the middle rail to provide drag relief for the cables. The short ends of the H.V. cables which are going to the H.V. generator must be routed in downward direction in this area.
The free cable lengths including plugs have to be about 1.5m.
- Twist the H.V. cables counter-clockwise by one turn and connect them to the H.V. generator.
The twisting of the cables allows that the H.V. cables can be put into a loop when the cabinet is placed against the wall.
- Check whether the H.V. sockets are filled with some oil. At least the lower half of the plugs must be wet with oil.

Caution!

Do not use a silicone washer.

Do not grease the plugs with silicone.

The union nuts of the high-voltage connectors must be tightened up to ensure good electrical contact for screening.

Only high-voltage connectors which have threaded flange halves may be used.

Older high-voltage cables still have connectors where the flange halves are kept together with a spring washer.

In such cases the modification kit 4512 103 8085x is required.

4.6. Emergency-OFF circuit

- Connect the emergency-OFF buttons to EZX4:1/2.
If not necessary, link pins 1 – 2.

See Z1-2.1 "Power supply" in "Schematic drawings" section and Z2-5.2 "Backpanel Basic rack-2Z" in the "Wiring diagrams" section.

5. Hardware programming

Programmings on PCB EZ150 basic interface:

Note

Never change jumper W1.

- Voltage supply for the amplifiers of connected measuring chambers:

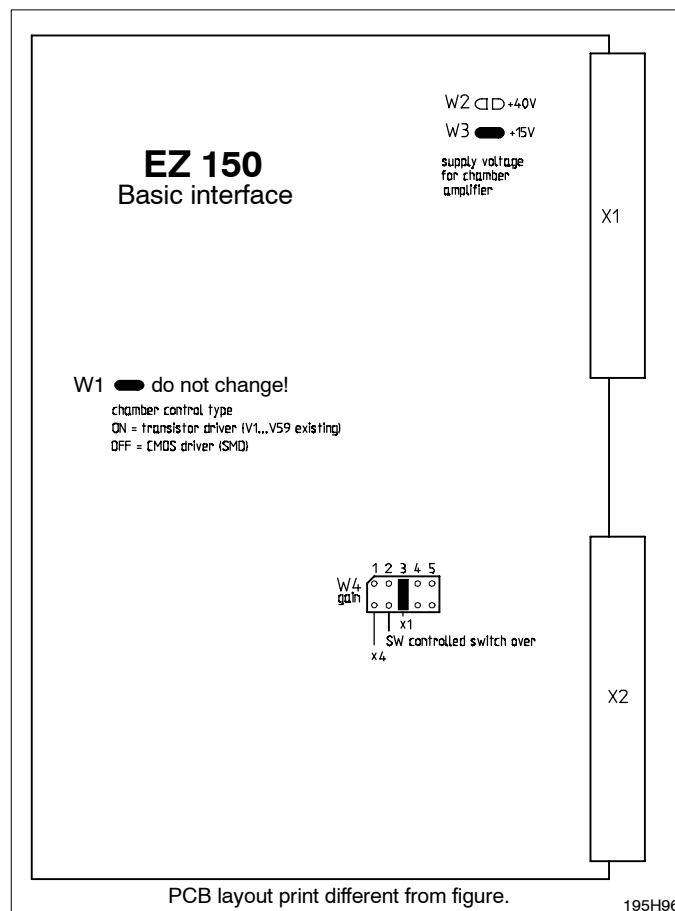
Voltage	Soldering link	
	EZ 150 W2	EZ 150 W3
15V default	OFF	ON

Working voltage range for ALC measuring chambers: 15 ... 45V

- Set the gain factor for AEC techniques with jumper EZ150:W4:
 - Factor 1 ==> W4 in position 3 = default
For screen/film combination with at least one system speed ≤ 200 .
 - Factor 4 ==> W4 in position 1
For screen/film combinations with all system speeds > 200 .

- The software programming has to be set accordingly.

The rest of the generator hardware has been properly programmed at the factory.
If required, refer to section 5: PROGRAMMINGS.



6. Switch-ON of the generator

- Switch ON the fuses present at the clinic.
- Switch ON automatic circuit-breakers ENF1, ENF2 and ENF3.

The yellow LED on EN100 power ON circuit must be illuminated.

7. Installation software XRGSCOPE

7.1. PC and generator settings to avoid problems during up/downloading of CU complete files

Any kind of interruption can cause the loading process to fail.

Problems occur mainly during the download to the PC.

A download file which is not complete cannot be used as a safety backup file.

Start XRGSCOPE always from DOS if possible.

When using any WINDOWS version:

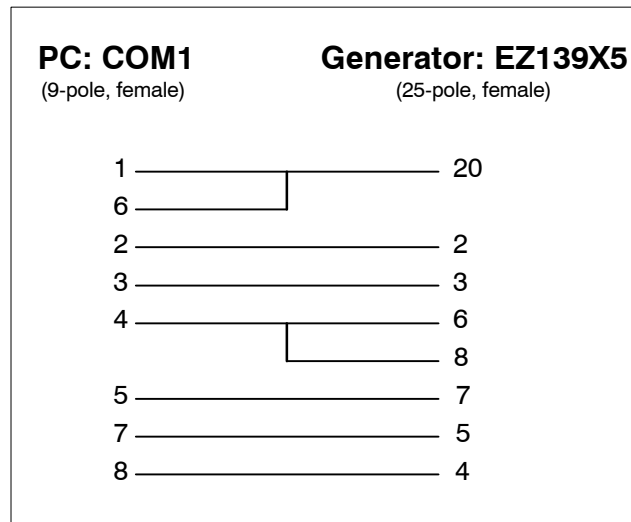
- Switch OFF all screensavers.
- Do not run other programs.
- Do not insert any CD in the drive.

Any kind of power management of the PC hardware (BIOS) as well as the windows power management should be switched OFF.

If connected to mains power some of these might be automatically OFF.

7.2. Installation procedure

- Provide the service PC with the hardware key and switch it ON.
The hardware key provides access to special program settings and to menu **"Faultfind"**.
Standard programming is possible without a hardware key.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable.
A 5m long data cable can be ordered via 12NC: 4512 130 5693x.
Data cable Optimus C Rel. 1.x for DuoDiagnost with handshake can also be used for Optimus RAD and R/F Rel. 3.x.



- Insert the floppy disks containing the self-unpacking exe-files of the firmware in the disk drive of the PC:
OMC: 4512 116 024xx
For unpacking on the harddisk of the PC about 5MB are needed.
- Generate a directory e.g. [C:\OPT_C] on the PC by entering **<md C:\OPT_C>** or use WIN commands.
- Copy the firmware from both floppy disks to the PC into the same directory C:\OPT_C by entering **<copy A:.* C:\OPT_C>** or use WIN commands.
- Start unpacking the programs by entering **<OMCxxxxx.exe>** or doubleclick on **<*.exe>** -file.
The programs unpack all files needed for the update of the firmware and the newest service tools.
- After unpacking [OMCxxxxx.exe] can be deleted on the harddisk by entering **<del OMCxxxxx.exe>**.
- For the current contents of [OMCxxxxx.exe] read [OMCxxxxx.txt] on the floppy disk.
- For a new installation of the generator firmware see section 4 REPLACEMENT, chapter 4
"Exchange or update of firmware ...".
- Call the installation program by entering **<xrgscope>** or **<xrgscope lcd>** for PCs with LCD screen.

- Start with an XRGSCOPE-screen CUSTOMER.tdl with data which are actually stored in CUSTOMER.tdl. Enter "XRGSCOPE customer".
Whenever data screens like 'error log index' are saved to an xxx.tdl file (function **save <F3>** appears in the bottom line), 'Customer Data' being saved in the CUSTOMER.tdl file are attached to the saved data screen. It helps to separate saved screen files of different sites, customers or rooms in the same hospital. Site data must be stored in CUSTOMER.tdl file, only data of this file are attached to the saved screens. One can save site specific customer data in self-made files using **<F3>**. To recall site data use the **load <F4>** function.

Procedure:

Either the CUSTOMER.tdl screen is open or open the 'Customer Data' screen. Push **<F4>** and select a site data file. The old data screen comes up. Now save this screen with **<F3>** entering in CUSTOMER as file name.

- Customer Name:
- City / State:
- Country:
- Generator Location:
- Generator Serial Number:
- Generator 12 NC:
- Memo1:
- Memo2:
- Memo3:

After **<ESC>** the following menu line appears:

<i>File</i>	<i>OPTIMUS C</i>	<i>Select Unit</i>	<i>Options</i>	<i>Help</i>
-------------	------------------	--------------------	----------------	-------------

- Select "OPTIMUS C".

The following menu line appears:

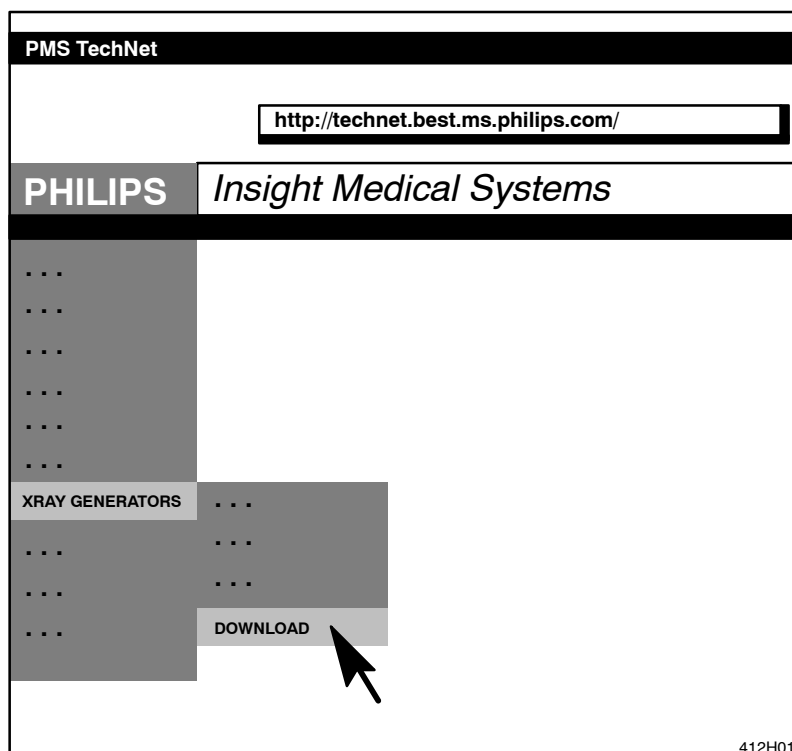
<i>Program</i>	<i>Adjust</i>	<i>Accept</i>	<i>Faultfind</i>	<i>Quit</i>
----------------	---------------	---------------	------------------	-------------

General information:

- Button <F1> <help> Call help / cancel help.
- Button <F2> <transmit> Store screen contents / data set in the generator ==> transmit to generator.
- Button <F3> <save> Store data screen on disk.
For an open data screen the path desired can be selected.
- Button <F4> <load> Load data set from disk. The desired path can be selected.
- Button <ESC> Commands one step back. Can be used repeatedly.
- Fields with ↓ Select the possible range of values by pushing <RETURN>.
The data are specified by the generator as fixed values.
- Fields with [...] Input of data via the keyboard.

Error numbers which appear at the beginning of the programming procedure must be erased from the screen by pushing the <RETURN> key.

Current data files, for instance, for online help, tube types, APR programming are available in the PHILIPS-Intranet. Use path: <http://technet.best.ms.philips.com/> and pull down menu as shown below.



If the installation program is called with <xrgscope ?> the possible starting parameters for the service program are listed.

8. Setting-to-work overview

Note

The programming of a generator must take place in the sequence specified below.

- Switch the generator ON.

8.1. Configuration

8.2. Tube adjustment

- RESET the generator

8.3. Dose rate control

- RESET the generator

8.4. Application limits

- RESET the generator

8.5. Area exposure product calculation (option). *Function not applicable for DuoDiagnost.*

8.6. Acceptance test

8.7. Backup of all configuration data

8.1. Configuration

- Switch the generator ON.

8.1.1. Date and time

- Select menu:
PROGRAM/ **DATE AND TIME**
- Enter the respective local data.

8.1.2. Mains data

- Select menu:
PROGRAM/ **MAINS DATA**
- Select the nominal value of the mains voltage U.
Range: 380V, 400V, 440V, 480V
Default: 400V
If 460V is present program 480V.
If 415V is present program 400V.
- Enter the maximum internal mains resistance R_i .
Range: 0 ... 500m Ω

Depending on the internal mains resistance and the mains voltage the generator calculates the maximum possible output.

8.1.3. Tube data set

- Select menu:
PROGRAM/ TUBES/TUBE 1 ... 3/ **TUBE 1**
- Start the displayed file *TUBExxx.tdl* with **<RETURN>**.
All the permitted combinations of tube type and housing type are listed in a window.
- Select the respective combination of tube type and housing type from the list and push **<RETURN>**.
- RESET the generator.
The data which have been configured up to now are read by the processor when the system is started.

8.1.4. Tube speed selection

Depending on the type of tube loaded the anode speed is automatically programmed.

Caution!

Wrong programming can cause tube problems.

- Select menu:
PROGRAM/ TUBES/TUBE 1 ... 3/ **TUBE 1**

Rotation	RPM \ tube type	
	RO	SRO
Exposure rotation [RPM]	3000	9000
Fast exposure rotation [RPM]	n/a	n/a
Fluoroscopy rotation [RPM]	3000	3000

8.1.5. Tube limits

- Select menu:
PROGRAM/ TUBES/ **TUBE LIMITS**
- Program the maximum working voltage which is indicated on the data label:

Max. tube voltage limit

Range: 40 ... 150kV

Default: 150kV

Adaptation of the tube takes place only up to this limit.

After adaptation of a tube the upper kV limit is displayed for each focus of each tube under:

Adapted to [kV]: e.g. 125kV

All the other limit programmings are performed by the generator automatically and do not usually have to be observed.

8.1.6. Capacitance of tube connection

- Select menu:
PROGRAM/ TUBES/ **CAPACITANCE TUBE CONNECTOR**

Range: 2.000 ... 10.000nF

The total capacitance for each tube connected is indicated:

$$C = \frac{1}{2} (C_{\text{H.V. generator}} + C_{\text{H.V. cable}})$$

$$= 4.550\text{nF}$$

Default for H.V. generator + 20m H.V. cable (155pF/m)

$$C [\text{nF}] = 3 + \frac{C_c \times L}{2000}$$

C_c = specific cable capacitance in [pF/m]

L = single cable length in [m]

Single length [m]	Capacitance tube connection [nF]	
	For 155pF/m cable	For 200pF/m cable
14	4.085	4.400
16	4.240	4.600
18	4.395	4.800
20	4.550	5.000
22	4.705	5.200
24	4.860	-
26	5.015	-
28	5.170	-
30	5.325	-

The high-voltage cables type 9806 402 6xx02 currently being supplied have a capacitance of 155pF/m.

8.1.7. Tube operating modes

- Select menu:
PROGRAM/ TUBES/ **TUBE OPERATING MODE**
 - Intermediate boost:

Select ...	Disable	=	During preparation the rated filament current is applied (default).
	Enable	=	During preparation a reduced filament current is applied. After the release of exposure boosting takes place for a short time before the exposure is released. Effective with tube currents > 80% of max. value.
 - Rotation prolongation after PREP:

Select ...	Disable	=	The tube is braked as soon as preparation has been cancelled.
	Enable	=	After cancellation of preparation the tube is only braked after 30s. Within this time preparation can be repeated as often as necessary. Recommended for paediatrics and casualty rooms.

8.1.8. Disable tube

For correction of the configuration.

- Select menu:
PROGRAM/ TUBES/ **DISABLE TUBE**

When the tube is disabled the above stored data set of the tube is erased. To enable the tube the data set has to be loaded again.

8.2. Tube adjustment

8.2.1. Tube conditioning

**Warning!****Radiation is released during the conditioning procedure!**

- RESET the generator. It must be in READY state.
- Select free cassette auxiliary.
- Select **large** focus only.
- Run reconditioning procedure for an adapted tube, refer to following table, left column TUBE ADAPTED.

or

- Run conditioning procedure for a new or non-adapted tube, refer to following table right column TUBE NOT ADAPTED.
- It is recommended that the high tension be monitored during conditioning.
Connect the scope:
Channel1: kV AV HT at EZ130 X3 (1V/div), scale: 20kV/V
Trigger external: CTRL_X_C/ at backpanel EZ X74, negative slope
Time base: 2ms/div
- In case of problems like tube arcing see the following flowchart EXPOSURE SEQUENCE as an example.
The flowchart applies for applicable kV range only, e. g.:
109kV is the max. kV value for normal application, perform just up to next higher kV step = 117kV.

Note

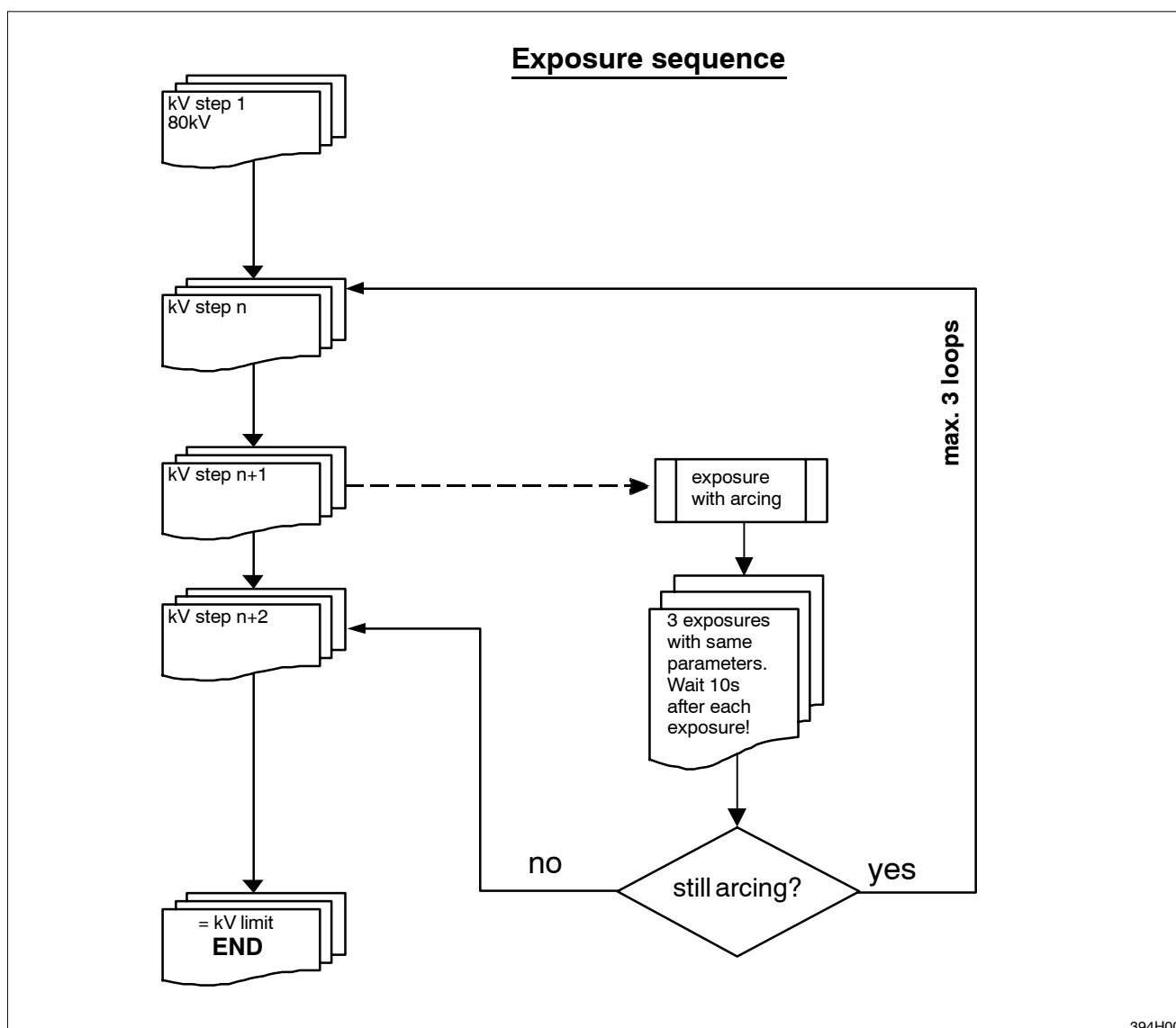
Refer to flowchart EXPOSURE SEQUENCE.

If the tube arcs at a certain kV value, switch another 3 exposures with same parameters and 10s pause between subsequent exposures. In case of success (no arcing anymore) continue with next kV step of the following table.

*If the last exposure still arcs go one kV step back and follow normal procedure. If this routine has been performed three times without improvement: ==> **Replace the tube!***

Exposure parameters for conditioning					
Tube adapted			# exposures	Tube not adapted	
kV	mA	ms		kV	mAs
80	10	50	< 1 >	80	0.5
80	10	500	< 1 >	80	5
80	200	250	< 1 >	80	50
10 seconds pause				10 seconds pause	
80	max. mA	100	< 1 >	80	100
1 minute pause				1 minute pause	
90	10	50	< 1 >	90	0.5
90	10	500	< 1 >	90	5
90	200	250	< 1 >	90	50
10 seconds pause				10 seconds pause	
90	max. mA	100	< 1 >	90	100
1 minute pause				1 minute pause	
100	10	50	< 1 >	100	0.5
100	10	500	< 1 >	100	5
100	200	250	< 1 >	100	50
10 seconds pause				10 seconds pause	
100	max. mA	100	< 1 >	100	100
1 minute pause				1 minute pause	
110	10	50	< 1 >	110	0.5
110	10	500	< 1 >	110	5
110	200	250	< 1 >	110	50
10 seconds pause				10 seconds pause	
110	max. mA	100	< 1 >	110	100
1 minute pause				1 minute pause	
120	10	50	< 1 >	120	0.5
120	10	500	< 1 >	120	5
120	200	250	< 1 >	120	50
10 seconds pause				10 seconds pause	
120	max. mA	100	< 1 >	120	100
1 minute pause				1 minute pause	
130	10	50	< 1 >	130	0.5
130	10	500	< 1 >	130	5
130	200	250	< 1 >	130	50
10 seconds pause				10 seconds pause	
130	max. mA	100	< 1 >	130	100
1 minute pause				1 minute pause	

Exposure parameters for conditioning					
Tube adapted			# exposures	Tube not adapted	
kV	mA	ms		kV	mAs
140	10	50	< 1 >	140	0.5
140	10	500	< 1 >	140	5
140	200	250	< 1 >	140	50
10 seconds pause				10 seconds pause	
140	max. mA	100	< 1 >	140	100
1 minute pause				1 minute pause	
145	10	50	< 1 >	145	0.5
145	10	500	< 1 >	145	5
145	200	250	< 1 >	145	50
10 seconds pause				10 seconds pause	
145	max. mA	100	< 1 >	145	100
1 minute pause				1 minute pause	
148	10	50	< 1 >	148	0.5
148	10	500	< 1 >	148	5
148	200	250	< 1 >	148	50
10 seconds pause				10 seconds pause	
148	max. mA	100	< 1 >	148	100
1 minute pause				1 minute pause	
150	10	50	< 1 >	150	0.5
150	10	500	< 1 >	150	5
150	200	250	< 1 >	150	50
10 seconds pause				10 seconds pause	
150	max. mA	100	< 1 >	150	100
1 minute pause				1 minute pause	

**Note**

If the tube arcs at any kV value which is not required for application the max. kV (e.g. 117kV) program this new limit value by XRGSCOPE:

PROGRAM/ TUBES/ TUBE LIMITS/ MAX. TUBE VOLTAGE LIMIT [kV]/ [117]

As the limit value decreases for this reason, a following re-adaptation procedure sets the field ADAPTED TO [kV] to this value as well.

- Set RGDV programming to original status if no adaptation procedure has to be executed.
- RESET the generator.

8.2.2. Tube adaptation



Warning!

Radiation is released during the adaptation procedure!

Note

*The tube must be properly conditioned before the adaptation procedure is started.
For break-in procedure see previous chapter 8.2.1. "Tube conditioning".*

Tube adaptation is an automatic process which includes:

1. The measurement of the mA offset of
 - the kV measuring circuit.
 - the emission current voltage / frequency converter.
2. The measurement of the individual standby filament current.
3. The kV dependent filament / emission current behavior.
4. The boost adaptation to calculate the positive and negative boost in one procedure.
For more information refer to section 3: FAULT FINDING.

Note

*In case of problems check the symptom / solution list at the end of this chapter.
Repeat the adaptation for this particular focus.*

- Press <**RETURN**>.

An opening screen asks to wait 20 seconds after the screen comes up.

- Press <**F2**> to transmit the data.

Tube: **1st Tube**
 2nd Tube not applicable
 3rd Tube not applicable

Focus: **small**
 medium a tube with a (third) medium filament does not exist yet, it is not VARIOFOCUS
 large

After data transmission COCKPIT displays [**Adaptation X-Ray tube**] (locally programmed language).
READY returns (waiting time is about 15 seconds).

- Push <**PREP**> and <**EXP**> button at the control desk or use footswitch.

The generator switches about 125 exposures for each focus.

The radiation sign at the desk indicates exposures and a beep is audible at the end of every exposure.

There is no display of the actual kV parameters during adaptation.

The termination of the adaptation procedure is indicated at the PC screen and a beep from the PC is audible.

- RESET the generator.
- Adapt **both** small and large focus to use VARIOFOCUS.
APRs using VARIOFOCUS cannot be selected as long as **both**, small and large are not adapted.
The COCKPIT screen indicates a non-adapted focus.

Problems during adaptation - Symptoms and solutions

1. A warning cannot be displayed on the control desk, the **[WAITING]** screen on the PC is flickering instead during this event and logged in the error log index.
2. If the tube has already been at a high temperature level (but the tube load indication still indicates green or green-yellow for 100% power) it might happen that the load indication changes straight to red and the adaptation is on hold.
[WAITING] is flickering on the PC.

Solution: Keep the handswitch pushed, once the temperature is down adaptation continues automatically.

Note

An increment of one of the temperature levels inhibits the 100% power condition. This event is always logged as warning 00BV in the error log index.

3. An error message just flashes for a very short moment and is instantly covered by **[ADAP]** on the desk afterwards.
[WAITING] is flickering on the PC.
4. All buttons at the control desk including the RESET button are inactive during adaptation.
The only way to RESET an error is to release the PREP switch which causes an interrupt similar to the RESET command.
5. After letting go of the PREP switch wait until the desk indicates **[READY]**. If **[READY]** does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.
6. If adaptation seems to do nothing for more than 30 seconds let go of the PREP switch. Wait until the desk indicates READY. If **[READY]** does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.
7. If a constant **[READY]** indication appears for more than 2 seconds while PREP and EXP is activated by the handswitch during adaptation let go of the handswitch.
Wait until the desk indicates **[READY]**. If **[READY]** does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.
8. If adaptation does not carry on with or without **[READY]** indication check whether one of the function units indicates a FATAL error by turning on the red LED. Let go of the handswitch and run a warmstart of the generator by pushing the RESET button on CU EZ139.
9. If adaptation has been interrupted by a generator warmstart check the error log index before restarting adaptation: kV errors 02WG and/or 02WH indicate tube arcing.
In this case run conditioning of the tube as described in chapter 8.2.1 and/or reduce the max. kV value to the required application value.

8.3. Dose rate control

8.3.1. AMPLIMAT sensitivity

- Select menu:
PROGRAM/ DOSE RATE CONTROL AMPLIMAT/ **SENSITIVITY**
- Depending on HW programming of jumper EZ150:W4. W4 programs sensitivity accordingly:

 high = × 4 = EZ150:W4 in position 1
 ====> All screen/film combinations with a system speed > 200.

 low = × 1 = EZ150:W4 in position 3
 ====> At least one screen/film combination with a system speed ≤ 200.

8.3.2. Screen/film combinations

5 screen/film combinations can be programmed for each of the 5 measuring chambers:

- Select menu:
PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT CHAMBER 1 + 2/ **DATA SET 1 ... 5**

The number of the chamber corresponds to the specified unit number of the dose measuring unit.

The choice between automatic and manual DRC processing is possible when an authorized hardware key is inserted in the PC.

Automatic is selected as default and must be used for the initial programming.
Data sets of adjacent rooms can be copied but have to be aligned afterwards.

Access manual DRC processing by pushing the **<ESC>** key.
The manual mode is suitable for:

- Copying complete programming to other measuring chambers.
- Setting the basic density.
- Changing the desk-displayed names of the programmed screen/film combinations.
- Creating backups of the DRC programmings.

8.3.2.1. Automatic DRC processing

- Select the desired data from the files offered for the following programming steps.

The files are part of the installation software.

- Select the programming field with the cursor and enter **<RETURN>**.
- Enter the desired file from the list offered.
- Select the desired data as required.

FILM:	File FILM.TDL	Film types according to description of the manufacturer.
	File FILM_BL/ _GR/ _UV.TDL	General classification of the film according to color, sensitivity S and RLF compensation.
SCREEN:	File SCREEN.TDL	Screen types according to description of the manufacturer.
	File LUMAT_LG.TDL	<ul style="list-style-type: none"> - Screen types according to luminous matter. - Imaging plates.
CHAMBER:	File CHAMBER.TDL	Different types of measuring chambers.
CASSETTE:	File CASSETTE.TDL	Different types of cassettes.
SYSTEM CORRECTION:	File SYSCOR.TDL	Select no corr. (ISO 9236-1)
CORRECTION FACTOR:	Default 1.00	Correction factor for switch-OFF dose.

Based on the combination of the components entered, the processor calculates the switch-OFF dose, kV correction and RLF compensation. The name for the screen/film combination, e.g. "B400", is taken from the "screen" default data set.

Dose Rate Control setting Optimus for Computed Radiography (PCR or other imaging plates)

The following example is for a 400 speed system, determined by the selection of the LG06 400 speed type from file LUMAT_LG.TDL (luminous groups).

Ignore the violet screen colour of LG06, the data set just requires its kV characteristic.

FILM:	File FILM.TDL	X-CONSTANT RLF=1
SCREEN:	File LUMAT_LG.TDL	LG06 S400 vi
CHAMBER:	File CHAMBER.TDL	<i>the installed chamber type</i>
CASSETTE:	File CASSETTE.TDL	normal cassette (def)
SYSTEM CORRECTION:	File SYSCOR.TDL	no corr. (ISO9236-1)
CORRECTION FACTOR:		1.00

Note

Film, screen, etc. data selected are not directly stored in the generator.

It is recommended that they be entered in the table "Data sets of chambers" 2Z-4 at the end of this section.

- RESET the generator.

Color and sensitivity class of the screen/film combination are displayed on the desk, e.g.: "B400".

Other screen/film combinations (data set 1 ... 5) for the chamber can be selected by the \pm buttons.

8.3.2.2. Manual DRC processing

The current data set of the screen/film combination is displayed.

* Abbreviation:	Abbreviation for the screen/film combination. Example: B400 = blue, speedclass 400.
Dose Request Chamber:	Sensitivity of the measuring chamber type in [$\mu\text{Gy/V}$].
* Dose of FSC:	Switch-OFF dose of the screen/film combination in [μGy]. Linear ratio with respect to the film density.
kV70-Char. U_0 ... 9:	Checkpoints for kV-dependent density correction.
kV70-Char. Drel_0 ... 9:	Relative correction value for the dose.
RLF t_0 ... 9:	Checkpoints for time-dependent density correction. (RLF = R eciprocity L aw F ailure).
RLF Drel_0 ... 9:	Relative correction value for the dose.
* = Only these fields may be changed according to the system requirements. All other fields must not be changed.	

- If required, change the data and the abbreviation name.
Usually no value except the basic density "Dose of FSC" must be changed (see next page).
- Transmit the data set with <F2>.
- RESET the generator.

The **SAVE** <F3> and **LOAD** <F4> functions of **XRGSCOPE** permit straightforward copying of the measuring chamber programmings.

8.3.2.3. Density correction for AEC technique (option)

Basic density per screen/film combination:

A hardware key is required at the PC for direct access to the switch-OFF dose.

- Make a test exposure for each screen/film combination.
To do so, set the density correction = 0.
- Determine the density of the test exposures.
- Select menu:
PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT/ CHAMBER 1 + 2/ **DATA SET 1 ... 5**
- Select manual DRC programming by pushing the **<ESC>** key.
- Correct the switch-OFF dose = "Dose of FSC" according to formular below:

$\text{New switch-OFF dose} = \frac{\text{Desired density}}{\text{Measured density}} \times \text{Old switch-OFF dose}$

- Transmit the data set by pushing the **<F2>** key.
- Repeat the procedure for each screen/film combination at each chamber.
- RESET the generator.

The switch-OFF dose can be set on the PC even without a hardware key.

To do so, call up the automatic DRC programming, repeat all the selections and change the correction factor for switch-OFF dose accordingly. Each time this programming is called up all the selections must be repeated.

8.3.3. Image intensifier (II)

- II lead time
- Density voltage correction: Default = 1V
- Dynamic factors

8.3.4. Fault exposure detection

Fault exposure detection is switched ON as a default for AEC and TDC. If in the initial phase of an exposure too little dose is measured, the exposure is aborted to protect the patient.

- Time of control measurement: 10% of backup time,
min. 250ms at TDC
- Dose minimum: 4% of set density voltage at AEC,
4 ... 10% at TDC
- Backup time AEC: Calculated time from 9.5 times mAs of the respective 2-factor technique,
max. 4s
- Backup time TDC: Exposure time set 0.3 ... 6s

This additional precaution can be switched OFF for both techniques individually in the menu:
PROGRAM/ DOSE RATE CONTROL/ FAULT EXPOSURE DETECTION/ **AEC OR TDC**

For details see section 4 FAULT FINDING, chapter "Optimus AEC switch-OFF philosophy".

This monitoring does not take effect in the following cases, irrespective of programming:

- Using screen/film combinations with high speed in AEC technique.
- Exposure time in TDC technique is shorter than 1s.

8.3.5. Continuous fluoroscopy

Factors for continuous fluoroscopy can be modified:

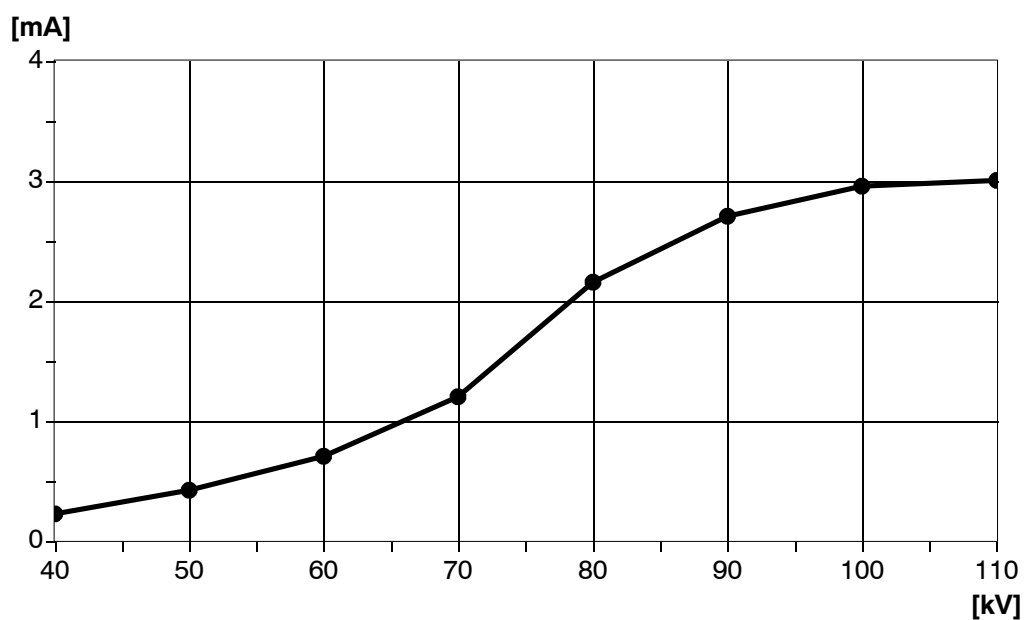
(see also section 4 FAULT FINDING, "Explanation of programming")

- scantime TV [ms] : = 20.00ms (default) for scantime of the TV system \leq 20ms (50Hz and 60Hz)
= Scantime of the TV system for scantime > 20ms
- scantime TV valid : = YES default
= NO no function yet
- P_max_EDL [W] : = 250W (default) (EDL = **E**ntrance **D**ose **L**imiter)
(range = 0 ... 9000W) The maximum output of the tube during continuous fluoroscopy and with the SID signal prevailing is limited to the programmed wattage.

Function not applicable for DuoDiagnost.

- TV_pos_limit [V] : = 6.8V (default) Adjustment necessary if the fluoroscopic image does not come
(range = +3 ... +7.5V) up properly.
See section 6 ADJUSTMENTS.
- TV_neg_limit [V] : = -6.8V (default)
(range = -7.5 ... -3V)

kV	mA
40	0.22
50	0.42
60	0.70
70	1.20
80	2.15
90	2.70
100	2.95
110	3.00



kV/mA - curve: Fluoroscopy Optimus C

8.4. Application limits

8.4.1. X-mode limits

Using the menu:

PROGRAM/ APPLICATION LIMITS/ **X-MODE LIMITS**

Limit values can be defined for all available techniques. Some values look as if they are out of limit which they are indeed, but there are additional basic limit values programmed in the generator firmware. These are exposure technique dependent.

As an example the field of the "Falling Load" technique:

X-ray Mode:	AEC falling load kV
Min. Time Limit [ms]:	[1.00]
Max. Time Limit [ms]:	[60000.00]
Min. Current Time Product Limit [mAs]:	[0.001]
Max. Current Time Product Limit [mAs]:	[580.000]

Min. Time Limit [ms]: Is always 1ms for all non-AEC (Automatic Exposure Control) techniques.
Exposures with AEC might be switched shorter than 1ms.

Max. Time Limit [ms]: Basic limits are technique dependent and can not be changed or increased:

AEC falling load	kV	4000ms
AEC fixed current	kV-mA	4000ms
TDC (Tomo Density Control)		6000ms
free techniques	[kV-mA-ms	16000ms
	| kV-mAs	16000ms
	L kV-mAs-ms	16000ms

Min. Current Time Product Limit [mAs]: The smallest mAs - product is 0.5mAs.
AEC exposures with less than 0.5mAs are possible.

Max. Current Time Product Limit [mAs]: The default mAs - product is 580mAs for all AEC-techniques.
850mAs is the absolute limit the generator terminates.

Note

Local limits have to be taken into consideration.

8.4.2. Thoravison limits

Function not applicable for DuoDiagnost.

8.4.3. Overload-dependent limits

- max. current for continuous fluoro [mA]: Range = 3 ... 30mA
- max current during overload for continuous fluoro [mA]: Range = 1 ... 3mA

8.5. Area exposure product calculation (option)

Function not applicable for DuoDiagnost.

8.6. Acceptance test

- Execute the acceptance test.
See section 7: ACCEPTANCE
- Observe all applicable national regulations.

For U.S.A applications check the H.H.S requirements!

After completion of setting-to-work, the system must be tested for H.H.S. compliance according the P.M.S.I. comprehensive compliance testing workbook: Numeric code 4535 800 2035x.

8.7. Backup of all configuration data

A hardware key is required for the PC.

To save the configuration data use the CONFIGURATION BACKUP disk supplied.

- Save the complete SW programming of the generator using the menu
ACCEPT/ BACKUP/ **CU Complete**
on the floppy disk:
 - Default file name: cubackup.tdl
 - Recommended file name: s/n of the generator, e.g. 026012.tdl
 - File size: approx. 600kB ... 700kB
 - Transfer time: approx. 15min (Restore time: approx. 0.25h ... 1h)
- Recommendation:
In addition, save the programmings for screen/film combinations using the menu
PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT/ CHAMBER 1 + 2/ **DATA SET 1...5**
(manual processing) and with the SAVE function <F3> key on floppy disk:
Recommended file name: drc##.tdl ## = Chamber and Data Set Number
- Provide the floppy disk with the serial number of the generator.
- Keep the floppy disk in the service documentation.

9. Labels

- Check the labelling according to the respective generator type.

See drawing 2Z-10 "Labelling".

All labels become visible by swiveling out the label bracket simply by hand and without any tool. The bracket is located at the top left corner of the front side of the cabinet, visibly marked by an "i" (for information) and text "Certified Component Labels Here". If the label bracket is swiveled 90 degrees to the right the following labels appear at its bottom side:

- X-ray control:
 - type designation
 - serial No. 6 digits
 - name and address of manufacturer
 - DHHS certification statement (if necessary)
 - date of manufacture
- X-ray H.V. generator:
 - type designation
 - serial No. 7 digits
 - name and address of manufacturer
 - DHHS certification statement (if necessary)
 - date of manufacture
- Technical data label with UL / CSA classification (if necessary).

10. Final installation work

- Mount the side panels of the generator cabinet.
- Take care that all cables inside the wall junction box are routed in **closed** loops without any kinks. Push the generator cabinet against the wall.



Warning!

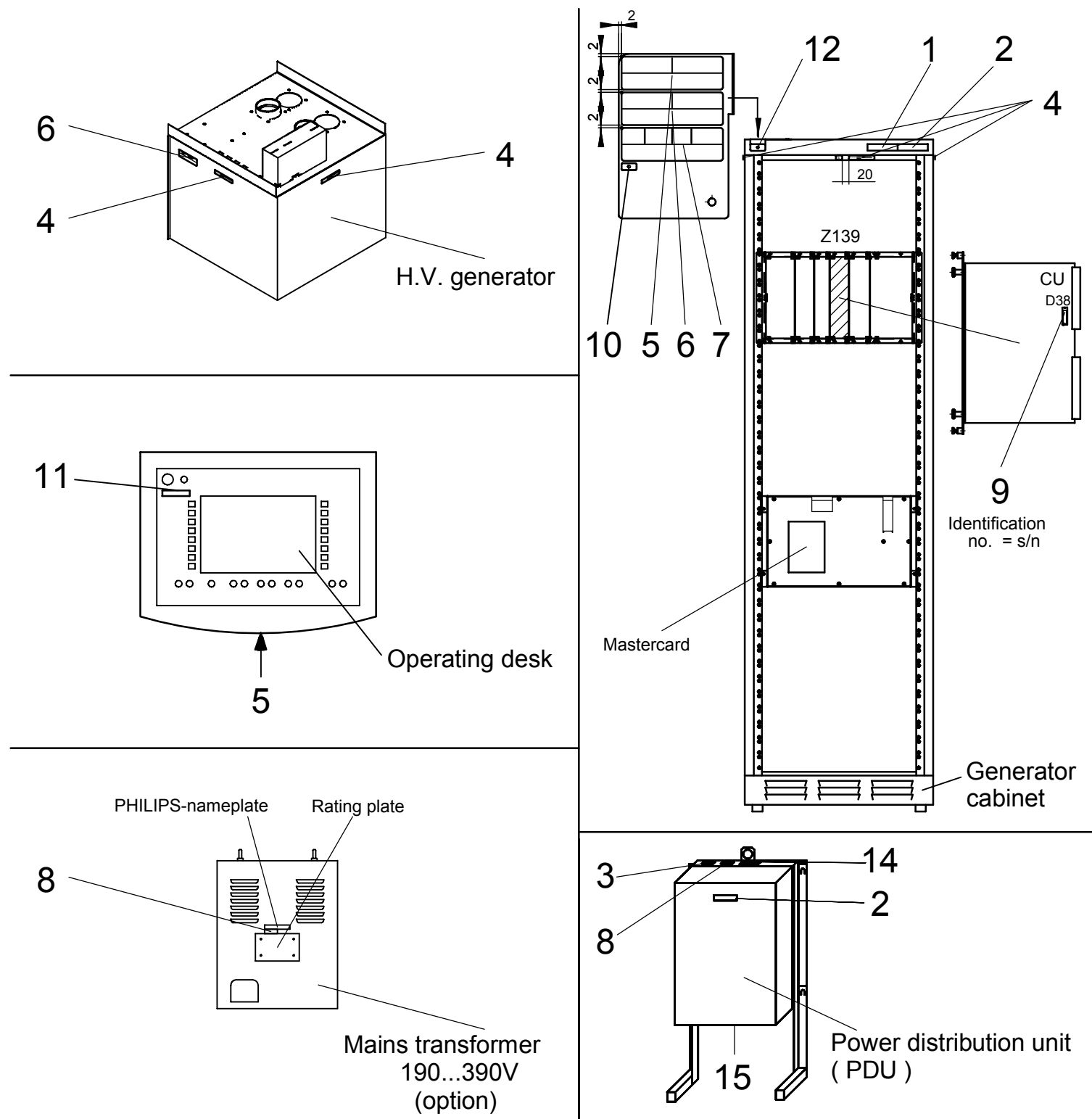
Block the two front wheels of the cabinet with the locking screws to guarantee that unauthorized persons cannot accidentally touch parts of the generator which might be dangerous.

- Level the cabinet with the locking screws.
- Mount the front cover of the generator.

	Chamber 1	Chamber 2	Chamber 3	Chamber 4	Chamber 5
Data Set 1	Film:	<i>Chambers 3; 4; 5 not applicable for DuoDiagnost.</i>		
	Screen: .....	.....		
	Chamber: .....	.....		
	Cassette: .....	.....		
	Sys.corr.: .....	.....		
	Dose of FSC: .....	.....		
Data Set 2	Film: .....	.....		
	Screen: .....	.....		
	Chamber: .....	.....		
	Cassette: .....	.....		
	Sys.corr.: .....	.....		
	Dose of FSC: .....	.....		
Data Set 3	Film:	<i>Chambers 3; 4; 5 not applicable for DuoDiagnost.</i>		
	Screen: .....	.....		
	Chamber: .....	.....		
	Cassette: .....	.....		
	Sys.corr.: .....	.....		
	Dose of FSC: .....	.....		
Data Set 4	Film: .....	.....		
	Screen: .....	.....		
	Chamber: .....	.....		
	Cassette: .....	.....		
	Sys.corr.: .....	.....		
	Dose of FSC: .....	.....		
Data Set 5	Film:	<i>Chambers 3; 4; 5 not applicable for DuoDiagnost.</i>		
	Screen: .....	.....		
	Chamber: .....	.....		
	Cassette: .....	.....		
	Sys.corr.: .....	.....		
	Dose of FSC: .....	.....		

A4 02-04-11 We
4512-983-06161_2Z_4_020

Data sets of chambers



1

OPTIMUS 50


1

OPTIMUS 65

1

OPTIMUS 80

2

 **PHILIPS**
MADE IN GERMANY




3

Philips Medical Systems
DMC GmbH
Röntgenstrasse 24
D-22335 Hamburg / Germany

4




CAUTION
HAZARD FOR LIVE AND /OR MOVING PARTS.
ATTENTION WHEN SERVICING ENERGIZED
EQUIPMENT.
OBSERVE THE SERVICE-MANUAL.

7
50
kW

50 kW	3~50/60Hz 400V 480V	 10A 8A	 145A 120A
CLASSIFIED  US			
- X-RAY EQUIPMENT - CLASSIFIED BY UNDERWRITERS LABORATORIES INC.® WITH RESPECT TO ELECTRICAL FIRE, SHOCK AND MECHANICAL HAZARDS ONLY. 641B			




UL
CSA

7
65
kW

65kW	3~50/60Hz 400V 480V	 10A 8A	 190A 160A
CLASSIFIED  US			
- X-RAY EQUIPMENT - CLASSIFIED BY UNDERWRITERS LABORATORIES INC.® WITH RESPECT TO ELECTRICAL FIRE, SHOCK AND MECHANICAL HAZARDS ONLY. 641B			

UL
CSA

7
80
kW

80kW	3~50/60Hz 400V 480V	 10A 8A	 230A 190A
CLASSIFIED  US			
- X-RAY EQUIPMENT - CLASSIFIED BY UNDERWRITERS LABORATORIES INC.® WITH RESPECT TO ELECTRICAL FIRE, SHOCK AND MECHANICAL HAZARDS ONLY. 641B			

UL
CSA

5

- X-RAY CONTROL - type 9890 000 0200x s/n xx xxxx OPTIMUS 50/65/80	Philips Medical Systems DMC GmbH Röntgenstr. 24 D-22335 Hamburg / Germany
CERTIFICATION This product complies with the Performance Standard under the Radiation Control for Health and Safety Act of 1968, applicable at date of manufacture. Manufactured: MONAT, JAHR	

6

- X-RAY HV GENERATOR - type 9890 000 xxxxx s/n xx xxxx OPTIMUS	Philips Medical Systems DMC GmbH Röntgenstr. 24 D-22335 Hamburg / Germany
CERTIFICATION This product complies with the Performance Standard under the Radiation Control for Health and Safety Act of 1968, applicable at date of manufacture. Manufactured: MONAT, JAHR	

13

- X-RAY CONTROL - type 9890 000 xxxxx s/n xx xxxx OPTIMUS	Philips Medical Systems DMC GmbH Röntgenstr. 24 D-22335 Hamburg / Germany
CERTIFICATION This product complies with the Performance Standard under the Radiation Control for Health and Safety Act of 1968, applicable at date of manufacture. Manufactured: MONAT, JAHR	


8

type	Produktname
s/n	Fabr. Nr.
code	Code Nr.

9

SN.


10

 0123


11

WARNING:
THIS X-RAY UNIT MAY BE DANGEROUS
TO PATIENT AND OPERATOR UNLESS SAFE
EXPOSURE FACTORS AND OPERATING
INSTRUCTIONS ARE OBSERVED.

12

 Certified
Component
Labels Here

14

3~50/60 Hz 400V 480V	11A 9A		
			

15

4512 104 7073.

FAULT FINDING**TEXT**

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DRAWINGS

Central rack, service aid	3Z-1
---------------------------------	------

1. Tools

- Service engineer mechanical tool kit
- mAs meter
- Multimeter
- Digital oscilloscope with 2-beam memory
- PC incl. 3.5" FDD, HW-dongle, serial interface cable, free RAM \geq 590kB
- Service software "XRGSCOPE" Version 2.2 or higher
- Recommended PLCC extraction tool (AMP 822154-1) 2422 487 89772

2. Notes



Warning!

After the generator has been switched OFF, hazardous voltages are still applied to the D.C. intermediate circuits of the converter, the rotor control and the mA control. These voltages are usually discharged within 2 minutes to values which are no longer dangerous.

For that reason always wait for a minimum of 2 minutes before starting any electrical work always after the generator has been switched OFF.

Note

Permanently interested in quality improvement of PMS products we depend on information from the field. Therefore please send us the current generator logfile information:

Please download the generator errorlog logfile in zipped format as described in chapter 4.4 "Saving data on disk and restoring data".

The filename must express the generator release and generator serial number.
E. g. "12020514.tdl" for Rel. "1.2" and serial number "020514".

Send this file containing the serial number of the generator and customer data attached to an E-Mail to:

Carsten Mais
Service Innovation Generators
PMS DMC Hamburg

E-Mail: Carsten.Mais@philips.com

Appreciate your help and many thanks in advance!

3. Strategy

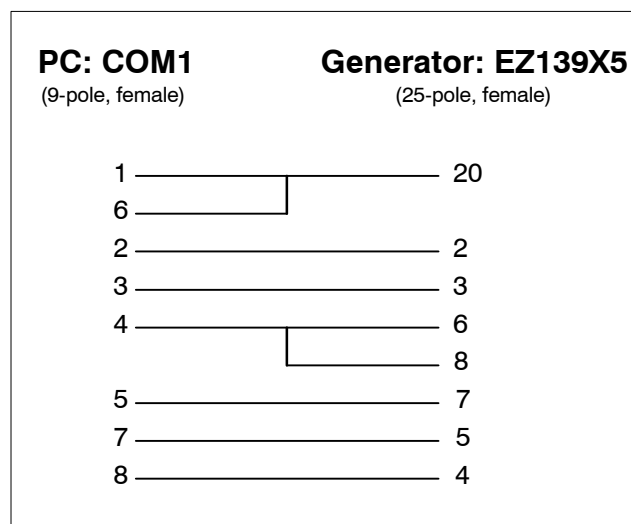
There are 3 categories of errors:

1. The generator cannot be switched ON at all or only for a short time.
 See ⇒ 5. "Initialization phase of the generator"
 ⇒ 6.1. "Switch ON not possible"
2. The generator can be switched ON but no error numbers are displayed on the operating desk.
 For fault finding use the service PC.
 See ⇒ 4.1. "Connecting the service PC"
 ⇒ 5. "Initialization phase of the generator"
 ⇒ 7. "Error numbers"
3. Error messages are displayed on the desk.
 For fault finding use the service PC.
 See ⇒ 4.1. "Connecting the service PC"
 ⇒ 7. "Error numbers"

4. Service-PC

4.1. Connection

- Switch the generator ON.
- Provide the service PC with the hardware key and switch it ON.
 The hardware key provides access to special program settings and to menu **"Faultfind"**.
 Standard programming is possible without a hardware key.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable:
 (A 5m long data cable can be ordered via 12NC: 4512 130 5693x)



4.2. Operation

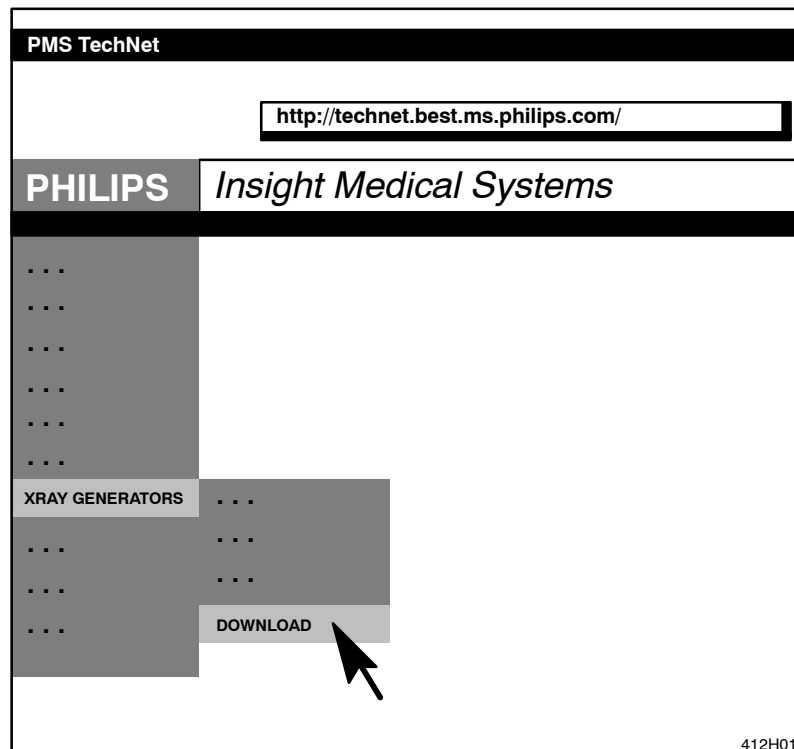
For installation of generator firmware and newest service tools see "REPLACEMENT" chapter "Exchange of firmware ...".

- Call the program with <xrgscope> or with <xrgscope lcd> for PCs with LCD screen.
- Enter your password.

The following menu line appears:

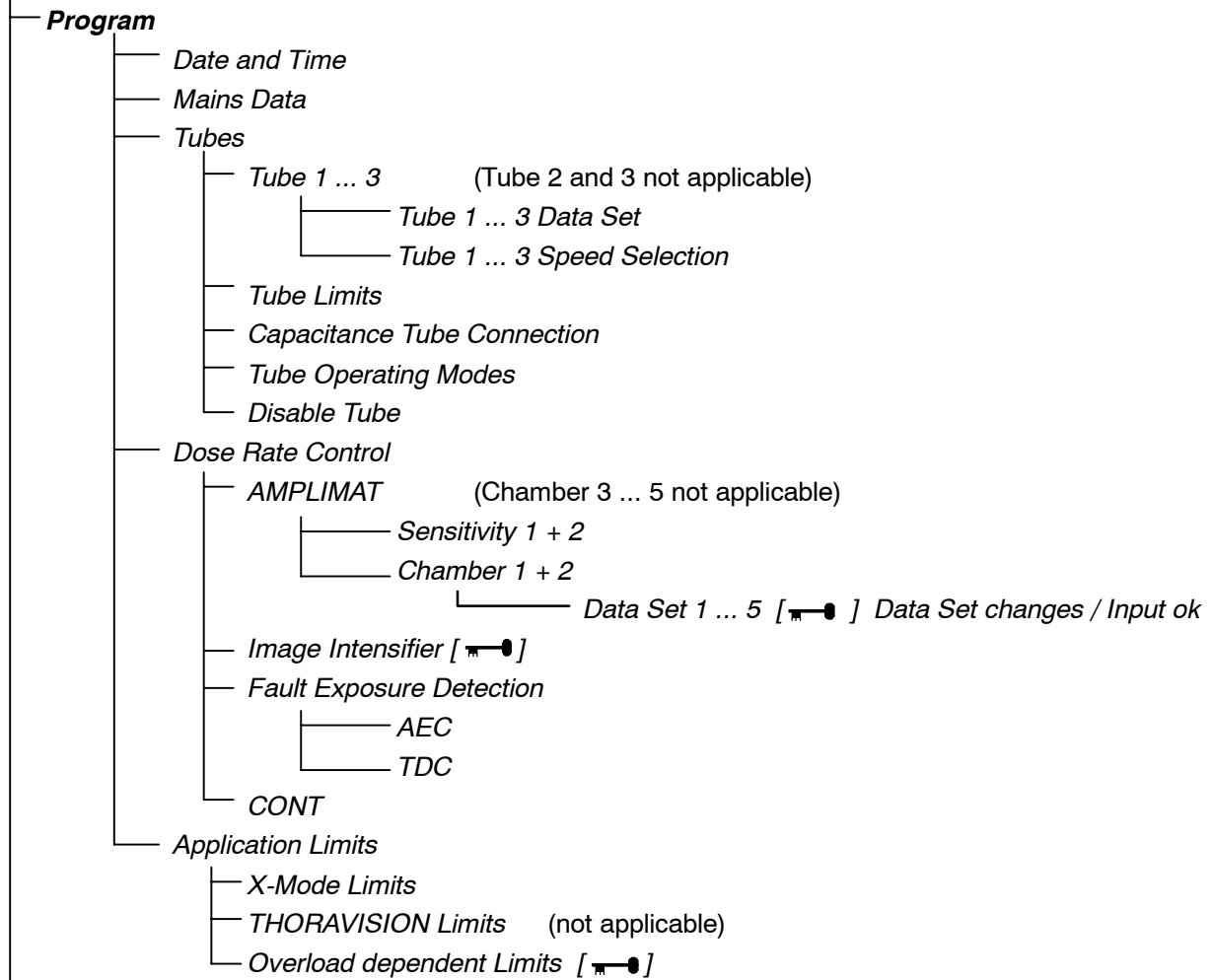
<i>File</i>	<i>OPTIMUS C</i>	<i>Select Unit</i>	<i>Options</i>	<i>Help</i>
-------------	------------------	--------------------	----------------	-------------

Current data files, for instance, for online help, tube types, APR programming are available in the PHILIPS-Intranet. Use path: <http://technet.best.ms.philips.com/> and pull down menu as shown below.

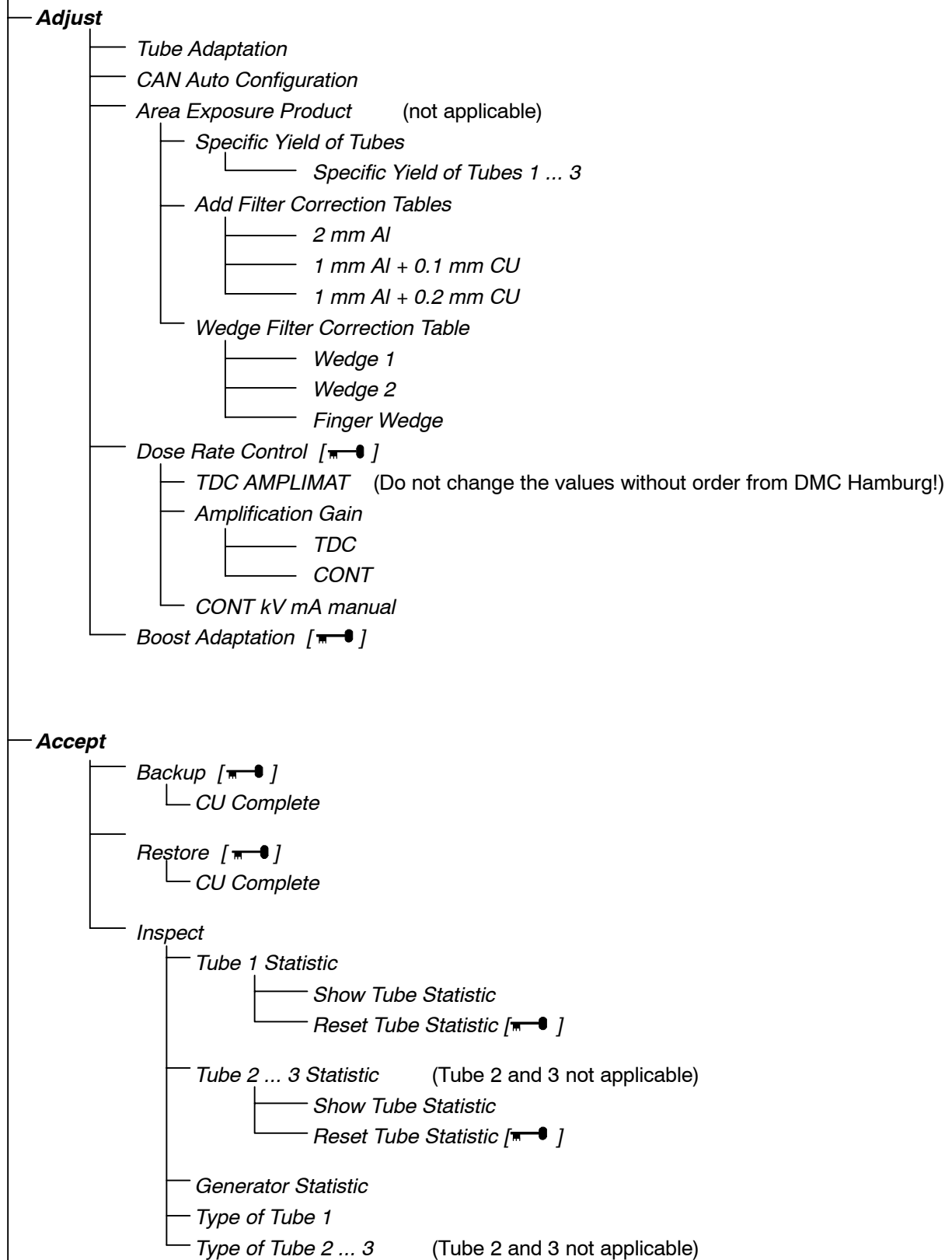


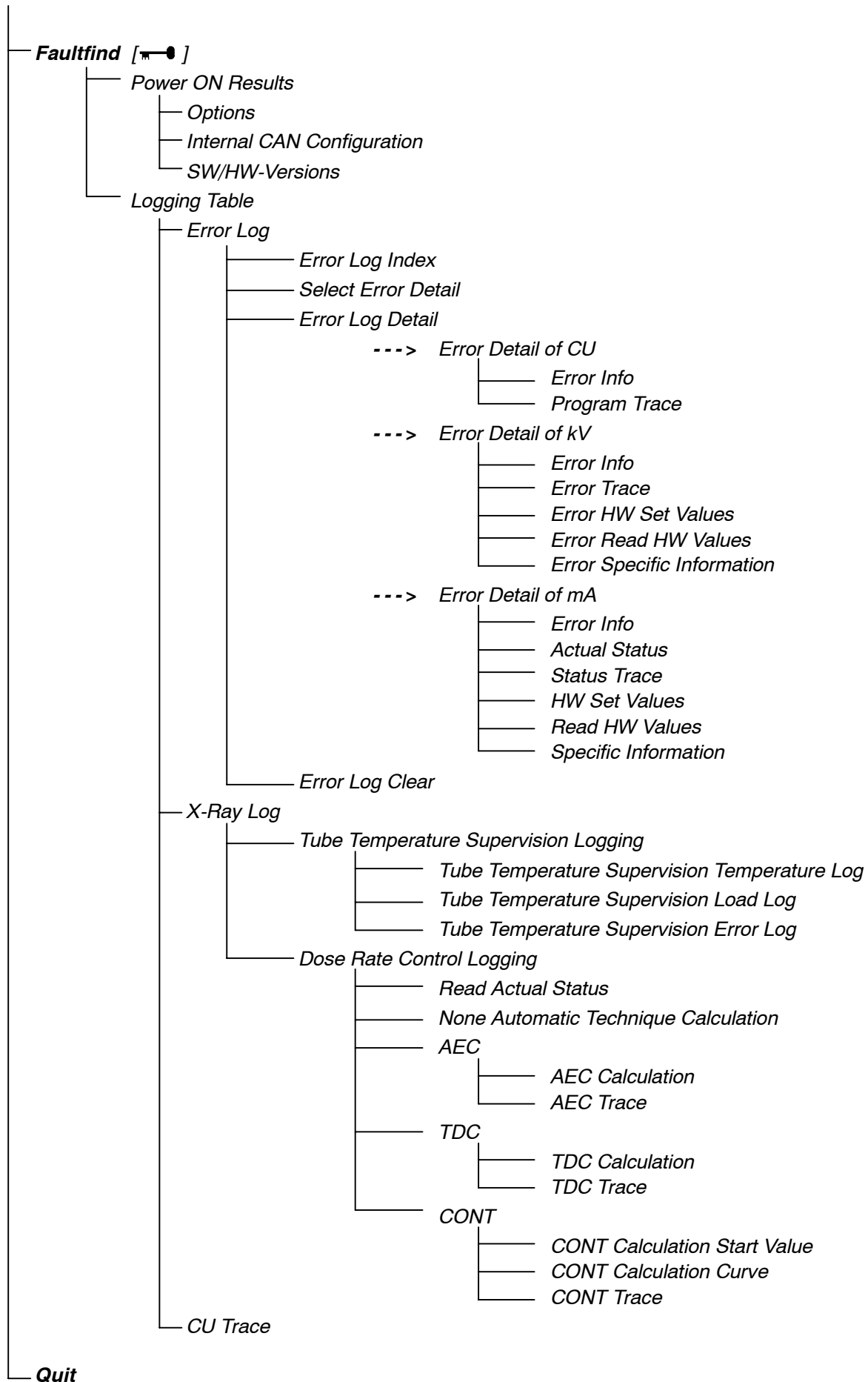
4.3. Menu structure

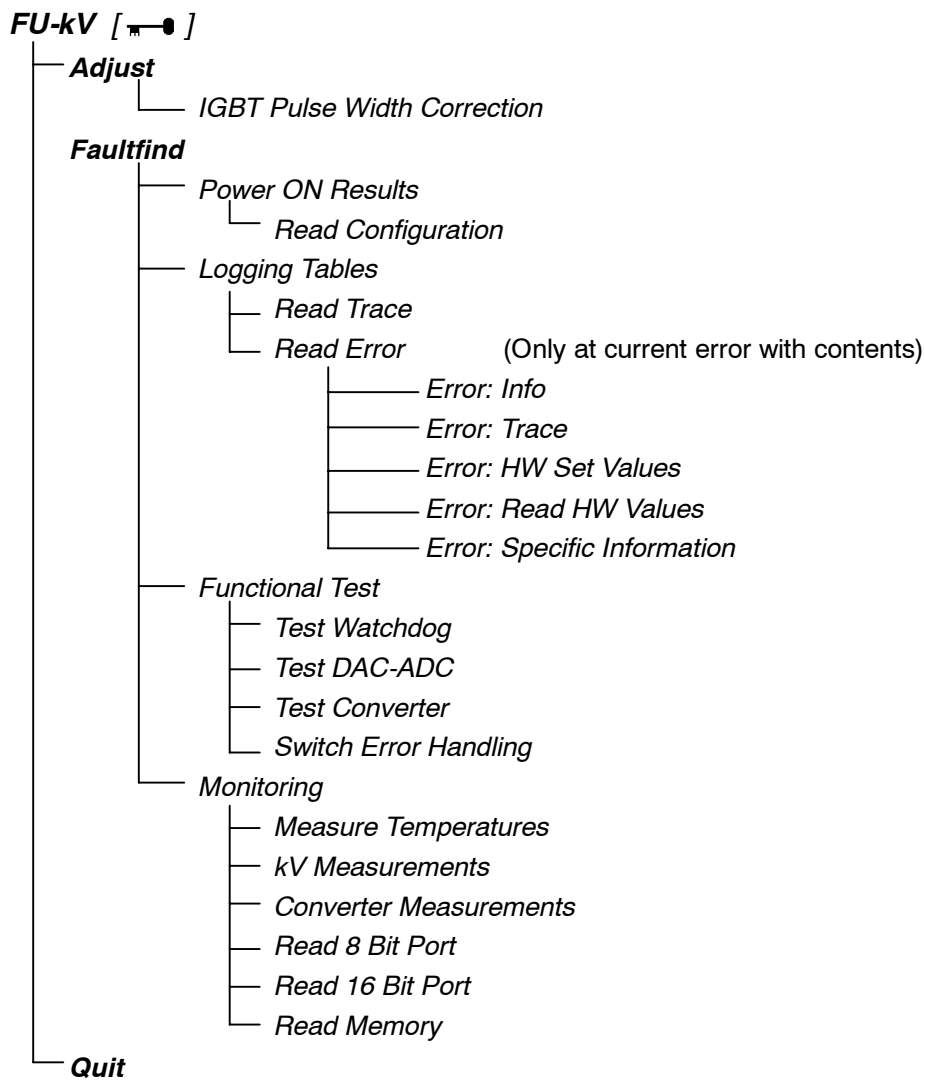
OPTIMUS



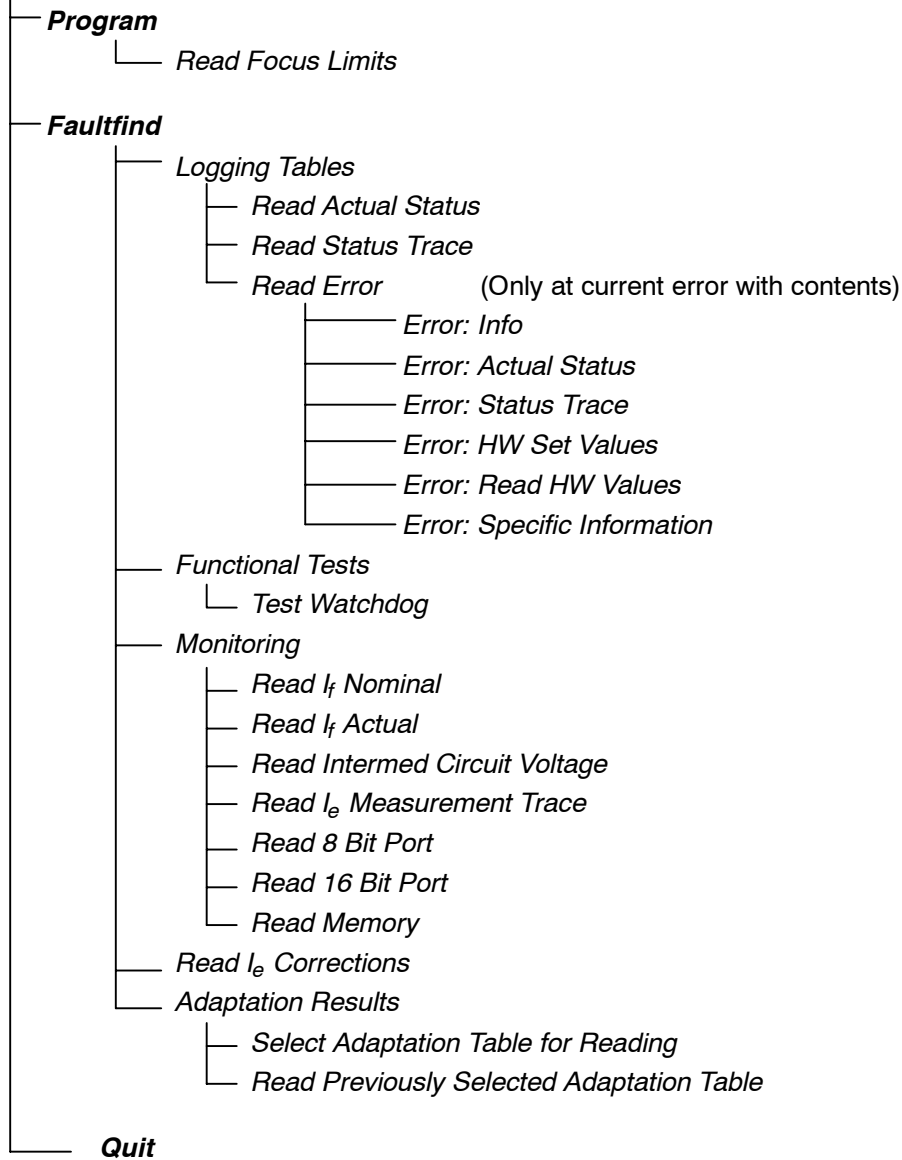
[] = A hardware key is required







FU-mA []



4.4. Saving data on disk and restoring data

All configuration data and logging tables are stored in battery-buffered CMOS areas of the CU board.

Therefore, these data have to be saved on disk as a backup.

In case data get lost they can easily be restored in the CMOS areas after the error source has been eliminated.

Note

In case of mailing CU complete download files or any other xxx.tdl files use a zipped file format. These files are ASCII files which might be destroyed while being mailed.

4.4.1. Saving of data

- Select menu:
ACCEPT/ BACKUP/ **CU COMPLETE**
- Store the data on floppy disk "Generator configuration data" found in the service documentation:

Default file name:	cubackup.tdl
Recommended file name:	s/n of the generator, e.g. 016012.tdl
File size:	approx. 500–700kB
Transfer time:	approx. 8min.
- Recommendation:

Additionally save the programmings for the film/screen combinations via the menu:
PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT/ CHAMBER 1 +2/ **DATA SET 1 ... 5** (manual processing)
Store them with the SAVE function <F3>-key on floppy disk.
Recommended file name: drc##.tdl ## = chamber and data set number

4.4.2. Restoring of data

- Select menu:
ACCEPT/ RESTORE/ **CU COMPLETE**
- Restore the data from floppy disk.
Transfer time approx. 15min ... 50min.
- Reset the generator.
- Program date and time.

Most of the programmings and logging tables can also be stored via the SAVE function <F3>-key of XRGSCOPE. Some programmings can be restored via the LOAD-function <F4>-key.

- For service use, only keep the latest version of the backup.

Note

Never use a complete backup for a different generator, only if the hardware, firmware and option configuration are identical.

5. Initialization phase of the generator

Start-up sequence

Switch ON of the generator.

|
V

Pulling-up of ENK2.

|
V

Selftest of ...

| ... central unit EZ139

| ... kV control EZ130 ---> voltage E is measured in the D.C. intermediate circuit

| ... mA control EZ119

| ... basic interface EZ150

| ... rotor control EY

|

| *Indicating device: The red status LED of the associated printed-circuit board or assembly is illuminated.*

|
V

After successful selftest the status LEDs blink.

|
V

The central unit establishes connection to each functional unit via the CAN bus.

|

| *Indicating device: The red status LED of the associated printed-circuit board or assembly grows dark.*

|
V

ENK1 is switched ON.

|
V

The generator is internally ready.

|
V

The external ready circuits are checked ---> unit ready, door contact closed, thermal contact of the tube closed, tube not overloaded

|
V

The green READY lamp in the operating desk is illuminated.====> **The generator is in the READY state.**

6. Switch ON problems

6.1. Switch ON not possible

See drawings: Z1-2.x

Z2-2.x.y

H1 on PCB EN100 is **not** illuminated

- Error sources:
- ENF1 was released.
For fault finding look in the error buffer.
 - ENF1 is not switched ON.
 - Mains voltage, especially phase L3, is not present.
 - ENF2 was released.
Check: Low-voltage supply
Filament circuit
Tube extension
Rotor control
External current consumers
 - ENF2 is not switched ON.
 - PCB EN100 or its connections are not okay.

H1 on PCB EN100 is illuminated

- Error sources:
- The emergency-OFF circuit is open.
 - The operating desk is not connected.

6.2. No start up

- Error sources:
- EN100 V1 is defective.
The generator receives a continuous reset via signalbus: reset sw/.
All red LEDs of the generator are illuminated.
Also see Z1-2.1.
 - No boot PROM present: EZ139 D3 (see 5Z-1).
 - Flash PROMs EZ139 D4/D5 not correctly loaded.

7. Error numbers

7.1. Error classification

Errors:

- Errors are indicated by 4 digits.
- The first two digits indicate the **F**unctional **U**nit FU reporting the error.
Example:
00xx = CU-functional unit is concerned
02xx = kV-functional unit is concerned
03xx = mA-functional unit is concerned
- The last two digits indicate the error symptom.

Displayed errors (ERROR and FATAL ERROR):

- These errors are indicated on the display of the operating desk for the customer.
Not all fatal errors come up on desk, use PC.
- The customer must call the service.
The customer can inform the service about the respective error number and the service can order the spare parts needed at an early stage of the maintenance procedure.

Not displayed errors (WARNING):

- These errors are not relevant for the customer.
- In case an error of this category occurs frequently within a certain period of time, a displayed error can be generated.

Note

No WARNINGS, but only ERRORS are displayed on the COCKPIT control desk.

7.2. Error list

Sources of error codes indicated in the first two digits decimally (hexadecimally):

Error code dec (hex)	FU (Function Unit)	Description
00xx	CU	- central unit EZ139
01xx	FU_DRC	- dose rate control, control physically located on CU EZ139 - parts of basic interface FU_CIE EZ150 also involved (Amplimat) - FU_DRC also handles fluoro kV control EZ130
02xx	FU_kV	- kV control EZ130
03xx	FU_mA_a	- 1 st mA control EZ119 - handles 2 filaments
07xx	FU_CIE	- central interface extension EZ150 basic interface
10xx (0Axx)	FU_RC_a	- 1 st rotor control high speed EY100

Error classes: FATAL ERROR, ERROR, WARNING

1. Errors as they occur in the error trace, XRGSCOPE and on the COCKPIT control desk, sorted by alphanumerical code.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
00B0	6106648	ERROR	CPU: Error in application data service interface	CU
00B9	6106657	ERROR	AD: Message from unknown function unit (FU)	CU
00BP	6106680	ERROR	AD: Unknown message from system controller	CU
00BZ		WARNING	AD: Select mode of an unused buffer	CU
00CB		WARNING	CONF: Received IIM #1#2H unknown	CU
00CC		WARNING	CAN: Frame-repeat-counter overflow (IIM #1#2H)	CU
00CD		WARNING	CAN: FU #1H not addressable	CU
00CE		WARNING	CAN: rx-signal conflict (FU #1H)	CU
00CF		WARNING	CAN: No RTR from FU #1H	CU
00CG		WARNING	CPU: Domain tx response Mailbox type wrong	CU
00CH		WARNING	CPU: Invalid tbdor-Parameter FU_type	CU
00CJ		WARNING	CAN: Auto configuration successful (#1H)	CU
00CK		WARNING	CAN: Auto configuration without success (#1H)	CU
00CL		WARNING	CAN: FU #1H not addressable	CU
00CM		WARNING	CAN: FU #1H sent event and did not answer RTR	CU
00CP		WARNING	CAN: Max FU count exceeded	CU
00CX		WARNING	CAN: Last-only-repeat-counter overflow (IIM #1#2H)	CU
00DA	6106865	ERROR WARNING	No CPU-Access to CAN-chip	CU
00DD		WARNING	CAN-chip DPRAM check failed	CU
00DE	6106869	ERROR WARNING	Unexpected CAN-chip int-pointer	CU
00DG		WARNING	CAN-chip error-active after passive #1H	CU
00DH		WARNING	CAN-chip state error-passive #1H	CU
00DI	6106873	ERROR	CAN-chip state bus-OFF #1H	CU
00DL	6106876	ERROR	Unexpected CAN-chip interrupt	CU
00DM		WARNING	CAN: Frame error (code #1H)	CU
00E0	6106948	ERROR	iRMX exception #2#1H occurred.	CU
00FA		WARNING	CPU: CAL(CS)-Errorcode: #2#1H	CU
00FB		WARNING	CPU: CS: Fast Domain Error	CU
00G0		WARNING	Variable in case statement has undefined value	CU

- 1) As it occurs in the error log and within XRGSCOPE.
- 2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
00G1	6107149	ERROR	Condition_code <> OK after CALL to send	CU
00G2		WARNING	Condition_code <> OK after CALL to init	CU
00I2		WARNING	No interrupt reason on sig-bus	CU
00I3		WARNING	No interrupt reason on XS-bus	CU
00I4	6107352	ERROR	One FU has a WD-error	CU
00J1	6107449	ERROR	DI: unknown IIM #1H	CU
00J2	6107450	ERROR	DI: rx LWDR param out of range FS= #1H PID= #2H	CU
00J3	6107451	ERROR	DI: rx LWDR message corrupted FS= #1H PID= #2H	CU
00J4	6107452	ERROR	DI: Internal table lookup failed FS= #1H PID= #2H	CU
00J5		WARNING	DI: tx LWDR param out of range FS= #1H PID= #2H	CU
00J6	6107454	ERROR	DI: tx LWDR param error FS= #1H PID= #2H ER= #3H	CU
00J7	6107455	ERROR	DI: LWDR message creation failed	CU
00J8		WARNING	DI: Unknown X-ray mode. No run data provided	CU
00J9		WARNING	DI: Message from suspended device ignored	CU
00JA		WARNING	DI: No interface version received, message ignored	CU
00JB	6107466	ERROR	DI: Unknown LWDR message received FS= #1H	CU
00JC	6107467	ERROR	DI: tx LWDR message size invalid FS= #1H	CU
00L1	6107649	ERROR	GC: Checksum error	CU
00L2	6107650	ERROR	GC: Data access error	CU
00L3	6107651	ERROR	GC: Limit data error	CU
00L4	6107652	ERROR	GC: Limits inconsistent	CU
00L5	6107653	ERROR	GC: Calculation error	CU
00L6	6107654	ERROR	GC: Function not implemented	CU
00M0	6107748	ERROR	Unable to initialize FU(s) #1H, #2H, #3H, #4H, #5H, #6H	CU
00M1	6107749	ERROR	Configuration key is missing or defective	CU
00M3	6107751	ERROR	No response at all from FU(s) #1H, #2H, #3H, #4H, #5H, #6H	CU
00M4	6107752	ERROR	Function value from SE out of range	CU
00M5	6107753	ERROR	Procedure index from SE out of range	CU
00MA		WARNING	Limit for allocated memory exceeded	CU
00MB		WARNING	Limit for available memory exceeded	CU
00MC		WARNING	Limit for borrowed memory exceeded	CU
00MD		WARNING	Allocated memory is increasing	CU

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
00ME		WARNING	Available memory is decreasing	CU
00MF		WARNING	Borrowed memory is increasing	CU
00MG		WARNING	NVRAM: Main control, NV checksum error	CU
00MH	6107772	ERROR	Job incorrectly identified	CU
00PA		WARNING	CPU: IIM/MSC number unknown	CU
00PB		WARNING	CPU: Technique mode unknown	CU
00PC		WARNING	CPU: Value limit overflow	CU
00PD	6108068	ERROR	PC comm.: Unknown TDL proc id	CU
00PE		WARNING	NVRAM: DRC NV checksum error	CU
00PF		WARNING	CPU: Equal kV-sets from CU comes twice	CU
00PG		WARNING	CPU: kV sequence does not increase	CU
00PH		WARNING	CPU: EDL is not possible, min_mA limit	CU
00PI		WARNING	CPU: DCALC Dr_curve has only one element	CU
00PJ		WARNING	CPU: DCALC Dr_curve has strange values	CU
00PK		WARNING	CPU: Equal kV-sets from CU with equal mA	CU
00PL		WARNING	CPU: Dose digits disturbance	CU
00S*		SERVICE	PC comm.: Service access trace	CU
00S?	6108363	ERROR	PC comm.: Unexpected error	CU
00S0	6108348	ERROR	PC comm.: Tube programming error	CU
00SA	6108365	ERROR	PC comm.: Not enough space at destination segment	CU
00SC	6108367	ERROR	PC comm.: Value too large	CU
00SD	6108368	ERROR	PC comm.: Terminator not found	CU
00SE	6108369	ERROR	PC comm.: Error in description	CU
00SF	6108370	ERROR	PC comm.: Item type unknown	CU
00SG	6108371	ERROR	PC comm.: Internal type unknown	CU
00SH	6108372	ERROR	PC comm.: Value negative	CU
00SJ	6108374	ERROR	PC comm.: Syntax wrong	CU
00SK	6108375	ERROR	PC comm.: String too long	CU
00SL		WARNING	PC comm.: String truncated	CU
00SM		WARNING	PC comm.: TDL segment overflow	CU

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
00SN	6108378	ERROR	PC comm.: FU reference table full	CU
00SO	6108379	ERROR	PC comm.: Node ID unknown	CU
00SP	6108380	ERROR	PC comm.: FU code unknown	CU
00SQ	6108381	ERROR	PC comm.: Syntax error in node ID	CU
00SR		WARNING	PC comm.: No node ID found	CU
00SS	6108383	ERROR	PC comm.: Request not performed	CU
00ST	6108384	ERROR	PC comm.: RMX error	CU
00SU		WARNING	PC comm.: Enumeration element not found	CU
00SV	6108386	ERROR	PC comm.: Mail corrupted	CU
00SW	6108387	ERROR	PC comm.: Procedure ID unknown	CU
00SX	6108388	ERROR	PC comm.: FU mA incompatible	CU
00SY	6108389	ERROR	PC comm.: FU Off request failed	CU
00SZ	6108390	ERROR	PC comm.: Wrong response	CU
00T?	6108463	ERROR	TTS: Unexpected error	CU
00TA	6108465	ERROR	TTS: Received message unknown	CU
00TB	6108466	ERROR	TTS: Tube supervision error from FU kV	CU
00TC	6108467	ERROR	TTS: Internal TTS error	CU
00TD	6108468	ERROR	TTS: Tube number unknown	CU
00TE	6108469	ERROR	TTS: NVRAM checksum error	CU
00TF	6108470	ERROR	TTS: NVRAM unavailable	CU
00TG	6108471	ERROR	TTS: Tube overheated	CU
00TH		WARNING	TTS: Load data supply inconsistent	CU
00X0	6108848	ERROR	CPU: Wrong timer id	CU
00X1	6108849	ERROR	CPU: Wrong timer mode	CU
00X2	6108850	ERROR	CPU: Wrong message type	CU
00X3		WARNING	CPU: DWORD does not fit into BYTE3	CU
00X4	6108852	ERROR WARNING	Timeout of X-ray backup timer	CU
00X5		WARNING	Timeout of X-ray rotation timer	CU
00X6		WARNING	Timeout setting FUs, response missing	CU
00X7		WARNING	CPU curve token is NO_TOKEN	CU

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
00XB		WARNING	NVRAM tube data rotation invalid	CU
00XC		WARNING	NVRAM watch dog invalid	CU
00XD		WARNING	NVRAM confi table invalid	CU
00XE		WARNING	NVRAM test data invalid	CU
00XF		WARNING	NVRAM RoCo data invalid	CU
00XI	6108873	ERROR	Init with FU-RoCo not OK	CU
00XJ	6108874	ERROR WARNING	Exposure time too short	CU
00XK		WARNING	CPU: FUmA refuses set data	CU
00XL		WARNING	NVRAM tube yield table invalid	CU
00XM		WARNING	NVRAM add filter corr table invalid	CU
00XN		WARNING	NVRAM wedge filter corr table invalid	CU
00XO	6108879	ERROR	Exposure time too long	CU
00XP		WARNING	Exposure time too long	CU
00XQ		WARNING	NVRAM tube statistic data invalid	CU
00XR		WARNING		CU
00XS		WARNING	Tube no in CU and FUkV different	CU
00XT		WARNING	Rotation in CU and FURoCo FUCIE diff.	CU
00XU	6108885	ERROR	Transition endless loop	CU
00XV		WARNING	NVRAM HW test flags invalid	CU
00XW	6108887	ERROR	EN_X active in startup	CU
00XX	6108888	ERROR	RD_PR_X stays active after prep	CU
02AB		WARNING	Procedure called with wrong parameter	FU_kV
02AC	6126567	ERROR	Wrong index for table access	FU_kV
02AD	6126568	ERROR	Wrong do case entry	FU_kV
02AE		WARNING	Unknown IIM received	FU_kV
02AF		WARNING	IIM parameter out of range	FU_kV
02CA		WARNING	Error in CASE selector	FU_kV
02CB		WARNING	A CAN message with wrong IIM-no (no recipient defined) received	FU_kV

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
02CC		WARNING	Multiple reception of the same CAN frame (transmitter ill)	FU_kV
02CE		WARNING	Unexpected signal value in CAN rx task	FU_kV
02CF		WARNING	CAN bus timeout while domain transmission	FU_kV
02CG		WARNING	Token of CAN response mailbox is not a mailbox token	FU_kV
02CX		WARNING	Multiple rx of the same CAN last/only frame (transmitter ill)	FU_kV
02CY		WARNING	Aborted CAN domain receive (because of timeout or wrong signal)	FU_kV
02CZ		WARNING	Unexpected CAN domain frame received (outside IIM-reception)	FU_kV
02DA		WARNING	No CPU access to the CAN controller	FU_kV
02DB		WARNING	Reset or release of the CAN controller was not acknowledged	FU_kV
02DD		WARNING	Check of the DPRAM of the CAN controller failed	FU_kV
02DE		WARNING	Unexpected interrupt pointer in the CAN controller	FU_kV
02DF		WARNING	CAN controller state undefined	FU_kV
02DG		WARNING	CAN controller state ERROR ACTIVE after ERROR PASSIVE	FU_kV
02DH		WARNING	CAN controller state ERROR PASSIVE	FU_kV
02DI		WARNING	CAN controller state BUS OFF	FU_kV
02DJ		WARNING	CAN controller state DPRAM ERROR	FU_kV
02DK		WARNING	CAN controller state DPRAM ERROR and ERROR PASSIVE	FU_kV
02EA	6126965	ERROR	Interrupt 0: Divide by zero	FU_kV
02EB	6126966	ERROR	Interrupt 1: Single step	FU_kV
02EC	6126967	ERROR	Interrupt 2: NMI	FU_kV
02ED	6126968	ERROR	Interrupt 3: Breakpoint	FU_kV
02EE	6126969	ERROR	Interrupt 4: Overflow exception	FU_kV
02EF	6126970	ERROR	Interrupt 5: Array bounds exception	FU_kV
02EG	6126971	ERROR	Interrupt 6: Unused opcode	FU_kV
02EH	6126972	ERROR	Interrupt 7: ESC opcode	FU_kV
02EI	6126973	ERROR	CAN connection to CU lost	FU_kV
02GA		WARNING	Interpolation not possible	FU_kV
02HA		WARNING	kV nominal value out of range	FU_kV
02HB	6127266	ERROR	kV nominal value out of range	FU_kV
02HC		WARNING	Z nominal value out of range	FU_kV

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
02HD	6127268	ERROR	Z nominal value out of range	FU_kV
02HE		WARNING	kV value during standby too large	FU_kV
02HF	6127270	ERROR	kV value during standby too large	FU_kV
02HG		WARNING	kV actual value out of range	FU_kV
02HH	6127272	ERROR	kV actual value out of range	FU_kV
02HI		WARNING	E value during standby out of range	FU_kV
02HJ	6127274	ERROR	E value during standby out of range	FU_kV
02HK		WARNING	E value during high tension out of range	FU_kV
02HL	6127276	ERROR	E value during high tension out of range	FU_kV
02HM		WARNING	Converter 1 temperature out of range	FU_kV
02HN	6127278	ERROR	Converter 1 temperature out of range	FU_kV
02HO		WARNING	Converter 2 temperature out of range	FU_kV
02HP	6127280	ERROR	Converter 2 temperature out of range	FU_kV
02HQ		WARNING	High voltage tank temperature out of range	FU_kV
02HR	6127282	ERROR	High voltage tank temperature out of range	FU_kV
02HS		WARNING	Divider test cathode out of range	FU_kV
02HT	6127284	ERROR	Divider test cathode out of range	FU_kV
02HU		WARNING	Divider test anode out of range	FU_kV
02HV	6127286	ERROR	Divider test anode out of range	FU_kV
02HW		WARNING	kV asymmetrical	FU_kV
02HX	6127288	ERROR	kV asymmetrical	FU_kV
02MA	6127765	ERROR	State request not accepted because of grid mode	FU_kV
02MB	6127766	ERROR	State request not accepted because of error state	FU_kV
02MC		WARNING	State requested by CU unknown	FU_kV
02OA	6127965	ERROR	RMX error: Timeout	FU_kV
02OB	6127966	ERROR	RMX error: Memory	FU_kV
02OC	6127967	ERROR	RMX error: Busy	FU_kV
02OE	6127969	ERROR	RMX error: Limit	FU_kV
02OF	6127970	ERROR	RMX error: Context	FU_kV
02OG	6127971	ERROR	RMX error: Exist	FU_kV
02OH	6127972	ERROR	RMX error: State	FU_kV

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
02OI	6127973	ERROR	RMX error: Not configured	FU_kV
02OJ	6127974	ERROR	RMX error: Interrupt saturation	FU_kV
02OK	6127975	ERROR	RMX error: Interrupt overflow	FU_kV
02OL	6127976	ERROR	RMX error: Transmission	FU_kV
02OM	6127977	ERROR	RMX error: Divide by zero	FU_kV
02ON	6127978	ERROR	RMX error: Overflow	FU_kV
02OO	6127979	ERROR	RMX error: Type	FU_kV
02OP	6127980	ERROR	RMX error: Parameter	FU_kV
02OQ	6127981	ERROR	RMX error: Bad call	FU_kV
02OR	6127982	ERROR	RMX error: Array bound	FU_kV
02OS	6127983	ERROR	RMX error: NDP error	FU_kV
02OT	6127984	ERROR	RMX error: Illegal opcode	FU_kV
02OU	6127985	ERROR	RMX error: Emulator trap	FU_kV
02OV	6127986	ERROR	RMX error: Interrupt table limit	FU_kV
02OW	6127987	ERROR	RMX error: CPU xfer data limit	FU_kV
02OX	6127988	ERROR	RMX error: Wrap around	FU_kV
02OY	6127989	ERROR	RMX error: Check exception	FU_kV
02OZ	6127990	ERROR	RMX error: Unknown	FU_kV
02RA		WARNING	Grid mode changeover requested during preparation	FU_kV
02RB		WARNING	Tube switch requested during preparation	FU_kV
02RC		WARNING	Requested P out of range	FU_kV
02SA		WARNING	Not enough space at the destination	FU_kV
02SB		WARNING	Base out of range	FU_kV
02SC		WARNING	PC comm.: Value too large	FU_kV
02SD		WARNING	Terminator not found	FU_kV
02SE		WARNING	PC comm.: Error in description	FU_kV
02SF		WARNING	PC comm.: Item type unknown	FU_kV
02SG		WARNING	PC comm.: Internal type unknown	FU_kV
02SH		WARNING	PC comm.: Value negative	FU_kV
02SI		WARNING	PC comm.: No space at dest. buffer	FU_kV

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
02SJ		WARNING	PC comm.: Syntax wrong	FU_kV
02SK		WARNING	PC comm.: String too long	FU_kV
02SL		WARNING	PC comm.: String truncated	FU_kV
02SO		WARNING	PC comm.: Unknown table ID received	FU_kV
02SP		WARNING	PC comm.: Access level to low	FU_kV
02SQ		WARNING	PC comm.: Unknown action requested	FU_kV
02SR		WARNING	PC comm.: Routing or message corrupt	FU_kV
02SS		WARNING	Source buffer to small for incoming message	FU_kV
02ST		WARNING	CAN buffer to small for outgoing message	FU_kV
02SU		WARNING	PC comm.: Access. level is N_A	FU_kV
02UA	6128565	ERROR	HW configuration identifier wrong	FU_kV
02UB		WARNING	Set up request received during preparation	FU_kV
02WA		WARNING	Wrong tube selected	FU_kV
02WB	6128766	ERROR	Wrong tube selected	FU_kV
02WC		WARNING	EN X C signal faulty	FU_kV
02WD	6128768	ERROR	EN X C signal faulty	FU_kV
02WE		WARNING	Wrong grid mode selected	FU_kV
02WF	6128770	ERROR	Wrong grid mode selected	FU_kV
02WG		WARNING	Tube arcing detected	FU_kV
02WH	6128772	ERROR	Tube arcing detected	FU_kV
02WI		WARNING	kV over voltage detected	FU_kV
02WJ	6128774	ERROR	kV over voltage detected	FU_kV
02WK		WARNING	Measuring not stable	FU_kV
02WL	6128776	ERROR	Tube supervision error	FU_kV
02WM	6128777	ERROR	Tube supervision error	FU_kV
03AA		WARNING	Internal parameter error	FU_mA
03AB		WARNING	Wrong parameter from CU	FU_mA
03AC		WARNING	Ie-regulation active on two filaments	FU_mA
03AI		WARNING	Wrong IIM received	FU_mA
03BA		WARNING	Coordinates not monotonous	FU_mA
03BB		WARNING	No measurement values for adap. found	FU_mA

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
03CA		WARNING	Error in CASE selector	FU_mA
03CB		WARNING	A CAN message with wrong IIM-no (no recipient defined) received	FU_mA
03CC		WARNING	Multiple reception of the same CAN frame (transmitter ill)	FU_mA
03CE		WARNING	Unexpected signal value in CAN rx task	FU_mA
03CF		WARNING	CAN bus timeout while domain transmission	FU_mA
03CG		WARNING	Token of CAN response mailbox is not a mailbox token	FU_mA
03CX		WARNING	Multiple rx of the same CAN last/only frame (transmitter ill)	FU_mA
03CY		WARNING	Aborted CAN domain receive (because of timeout or wrong signal)	FU_mA
03CZ		WARNING	Unexpected CAN domain frame received (outside IIM-reception)	FU_mA
03DA		WARNING	No CPU access to the CAN controller	FU_mA
03DB		WARNING	Reset or release of the CAN controller was not acknowledged	FU_mA
03DD		WARNING	Check of the DPRAM of the CAN controller failed	FU_mA
03DE		WARNING	Unexpected interrupt pointer in the CAN controller	FU_mA
03DF		WARNING	CAN controller state undefined	FU_mA
03DG		WARNING	CAN controller state ERROR ACTIVE after ERROR PASSIVE	FU_mA
03DH		WARNING	CAN controller state ERROR PASSIVE	FU_mA
03DI		WARNING	CAN controller state BUS OFF	FU_mA
03DJ		WARNING	CAN controller state DPRAM ERROR	FU_mA
03DK		WARNING	CAN controller state DPRAM ERROR and ERROR PASSIVE	FU_mA
03EA	6136965	ERROR	CPU interrupt 0	FU_mA
03EB	6136966	ERROR	CPU interrupt 1	FU_mA
03ED	6136968	ERROR	CPU interrupt 3	FU_mA
03EE	6136969	ERROR	CPU interrupt 4	FU_mA
03EF	6136970	ERROR	CPU interrupt 5	FU_mA
03EG	6136971	ERROR	CPU interrupt 6	FU_mA
03EH	6136972	ERROR	CPU interrupt 7	FU_mA
03EI	6136973	ERROR	CAN is unable to send an error to CU	FU_mA
03FA		WARNING	NVRAM: Invalid checksum	FU_mA
03FB		WARNING	NVRAM: Standby filament not found	FU_mA
03FC	6137067	ERROR	No NVRAM plugged in	FU_mA
03FD		WARNING	NVRAM empty	FU_mA

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
03GA	6137165	ERROR	Limit error	FU_mA
03GB		WARNING	Real math. error: Real underflow	FU_mA
03GC		WARNING	Real math. error: Real overflow	FU_mA
03GD		WARNING	Real math. error: Dword overflow	FU_mA
03GE		WARNING	Real math. error: Integer overflow	FU_mA
03GF		WARNING	Real math. error: Word overflow	FU_mA
03GG		WARNING	Singular matrix	FU_mA
03HA	6137265	ERROR	Unknown hardware	FU_mA
03HB	6137266	WARNING ERROR	Intermediate circuit voltage < 200V	FU_mA
03HF		WARNING	Undefined analog input channel	FU_mA
03HG		WARNING	If-actual out of tolerance	FU_mA
03HH	6137272	ERROR	If setpoint too large	FU_mA
03HI	6137273	ERROR	If-actual out of tolerance	FU_mA
03HJ	6137274	ERROR	If-actual out of tolerance	FU_mA
03HK		WARNING	If-nominal out of tolerance	FU_mA
03HL	6137276	ERROR	If-nominal out of tolerance	FU_mA
03HM	6137277	ERROR	If-nominal out of tolerance	FU_mA
03HN	6137278	ERROR	No retrigger received from CU	FU_mA
03IA		WARNING	Adaptation can not be completed	FU_mA
03IC		WARNING	No Ie-adaptation measurement values	FU_mA
03ID		WARNING	Ie-adaptation values not evolvable	FU_mA
03KA		WARNING	Condi.-X-Ray mode without mAs parameter	FU_mA
03MA		WARNING	Undefined status	FU_mA
03MB		WARNING	Status change not allowed	FU_mA
03MC		WARNING	FU init data not expected	FU_mA
03OA	6137965	ERROR	RMX exception: E\$TIME	FU_mA
03OB	6137966	ERROR	RMX exception: E\$MEM	FU_mA
03OC	6137967	ERROR	RMX exception: E\$BUSY	FU_mA
03OD	6137968	ERROR	RMX exception: E\$LIMIT	FU_mA
03OE	6137969	ERROR	RMX exception: E\$CONTEXT	FU_mA
03OF	6137970	ERROR	RMX exception: E\$EXIST	FU_mA
03OG	6137971	ERROR	RMX exception: E\$STATE	FU_mA

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
03OH	6137972	ERROR	RMX exception: E\$NOT\$CONFIGURED	FU_mA
03OI	6137973	ERROR	RMX exception: E\$INTERRUPT\$SATURATION	FU_mA
03OJ	6137974	ERROR	RMX exception: E\$INTERRUPT\$OVERFLOW	FU_mA
03OK	6137975	ERROR	RMX exception: E\$TRANSMISSION	FU_mA
03OL	6137976	ERROR	RMX exception: E\$ZERO\$DIVIDE	FU_mA
03OM	6137977	ERROR	RMX exception: E\$OVERFLOW	FU_mA
03ON	6137978	ERROR	RMX exception: E\$TYPE	FU_mA
03OO	6137979	ERROR	RMX exception: E\$PARAM	FU_mA
03OP	6137980	ERROR	RMX exception: E\$BAD\$CALL	FU_mA
03OQ	6137981	ERROR	RMX exception: E\$ARRAY\$BOUND	FU_mA
03OR	6137982	ERROR	RMX exception: E\$NDP\$ERROR	FU_mA
03OS	6137983	ERROR	RMX exception: E\$ILLEGAL\$OPCODE	FU_mA
03OT	6137984	ERROR	RMX exception: E\$EMULATOR\$TRAP	FU_mA
03OU	6137985	ERROR	RMX exception: E\$INTERRUPT\$TABLE\$LIMIT	FU_mA
03OV	6137986	ERROR	RMX exception: E\$CPUXFER\$DATA\$LIMIT	FU_mA
03OW	6137987	ERROR	RMX exception: E\$SEG\$WRAP\$AROUND	FU_mA
03OX	6137988	ERROR	RMX exception: E\$CHECK\$EXCEPTION	FU_mA
03OY	6137989	ERROR	Unknown RMX exception	FU_mA
03PA	6138065	ERROR	Ie zero measured	FU_mA
03PB		WARNING	Ie out of tolerance	FU_mA
03PC	6138067	ERROR	Ie out of tolerance	FU_mA
03PD		WARNING	Setpoint for Ie-regulation incorrect	FU_mA
03PE	6138069	ERROR	Emergency OFF, grid not closed!	FU_mA
03PF	6138070	ERROR	No kV discharged due to missing Ie	FU_mA
03SC		WARNING	PC comm.: Value too large	FU_mA
03SE		WARNING	PC comm.: Error in description	FU_mA
03SF		WARNING	PC comm.: Item type unknown	FU_mA
03SG		WARNING	PC comm.: Internal type unknown	FU_mA
03SH		WARNING	PC comm.: Value negative	FU_mA
03SI		WARNING	PC comm.: No space at dest. buffer	FU_mA
03SJ		WARNING	PC comm.: Syntax wrong	FU_mA

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
03SK		WARNING	PC comm.: String too long	FU_mA
03SL		WARNING	PC comm.: String truncated	FU_mA
03SO		WARNING	PC comm.: Unknown Table ID Received	FU_mA
03SP		WARNING	PC comm.: Access Level to Low	FU_mA
03SQ		WARNING	PC comm.: Unknown Action Requested	FU_mA
03SR		WARNING	PC comm.: Routing or Message Corrupt	FU_mA
03SU		WARNING	PC comm.: Access. level is N_A	FU_mA
07CA	6176765	ERROR	CAN: Case-selector error	FU_cIE
07CB		WARNING	CAN: Invalid CAN ID %u	FU_cIE
07CC	6176767	ERROR	CAN: Frame rep. overflow IIM%u	FU_cIE
07CD	6176768	ERROR	CAN: No RTR from CU	FU_cIE
07CE	6176769	ERROR	CAN: rx signal conflict IIM%u	FU_cIE
07CF	6176770	ERROR	CAN: tx timeout	FU_cIE
07CI		WARNING	CAN: IMPOSSIBLE ERROR	FU_cIE
07CP		WARNING	CAN: CPU: PXerr %d %s(%d)	FU_cIE
07CR		WARNING	CAN: CPU: message request fail	FU_cIE
07CS		WARNING	CAN: CPU: message send error	FU_cIE
07CY	6176789	ERROR	CAN: rx abort IIM%u	FU_cIE
07CZ		WARNING	CAN: Unexpected frame (IIM%u)	FU_cIE
07DA	6176865	ERROR	CAN: Chip access error	FU_cIE
07DB	6176866	ERROR	CAN: Chip reset error	FU_cIE
07DC	6176867	ERROR	CAN: Chip reset release error	FU_cIE
07DE		WARNING	CAN: Illegal interrupt pointer	FU_cIE
07DF	6176870	ERROR	CAN: Chip state undefined	FU_cIE
07DG		WARNING	CAN: Chip err act. after pass.	FU_cIE
07DH		WARNING	CAN: Chip state error passive	FU_cIE
07DI		WARNING	CAN: Chip state bus-OFF	FU_cIE
07DJ	6176874	ERROR	CAN: Chip DPRAM error	FU_cIE
07DK		WARNING	CAN: Chip DPRAM error&passive	FU_cIE
07DL		WARNING	CAN: Unexpected interrupt	FU_cIE

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
07LA		WARNING	CV received IIM unknown	FU_CIE
07LB		WARNING	RC stator number out of range	FU_CIE
07LC		WARNING	RC stator not available	FU_CIE
07LD	6177668	ERROR	RC stator 1 readback failed	FU_CIE
07LE	6177669	ERROR	RC stator 2 readback failed	FU_CIE
07LF	6177670	ERROR	RC stator 3 readback failed	FU_CIE
07LG		WARNING	RC speed value out of range	FU_CIE
07LH	6177672	ERROR	RC speed set timeout	FU_CIE
07LI		WARNING	RC maximal stator load exceeded	FU_CIE
07LJ	6177674	ERROR	RC maximal rotation time exceeded	FU_CIE
07LK		WARNING	AM amplimat chamber number out of range	FU_CIE
07LL		WARNING	AM amplimat field number out of range	FU_CIE
07LM		WARNING	AM amplimat delay value out of range	FU_CIE
10CA	6156765	ERROR	CAN: Case-selector error	FU_RC
10CB		WARNING	CAN: Invalid CAN ID %u	FU_RC
10CC	6156767	ERROR	CAN: Frame rep. overflow IIM%u	FU_RC
10CD	6156768	ERROR	CAN: No RTR from CU	FU_RC
10CE	6156769	ERROR	CAN: rx signal conflict IIM%u	FU_RC
10CF	6156770	ERROR	CAN: tx timeout	FU_RC
10CI		WARNING	CAN: IMPOSSIBLE ERROR	FU_RC
10CP		WARNING	CAN: CPU: PXerr %d %s(%d)	FU_RC
10CR		WARNING	CAN: CPU: message request fail	FU_RC
10CS		WARNING	CAN: CPU: message send error	FU_RC
10CY	6156789	ERROR	CAN: rx abort IIM%u	FU_RC
10CZ		WARNING	CAN: Unexpected frame (IIM%u)	FU_RC
10DA	6156865	ERROR	CAN: Chip access error	FU_RC
10DB	6156866	ERROR	CAN: Chip reset error	FU_RC
10DC	6156867	ERROR	CAN: Chip reset release error	FU_RC
10DE		WARNING	CAN: Illegal interrupt pointer	FU_RC
10DF	6156870	ERROR	CAN: Chip state undefined	FU_RC
10DG		WARNING	CAN: Chip err act. after pass.	FU_RC

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

Error Code ¹	Error Code ²	Error Class	Error Text	FU
10DH		WARNING	CAN: Chip state error passive	FU_RC
10DI		WARNING	CAN: Chip state bus-OFF	FU_RC
10DJ	6156874	ERROR	CAN: Chip DPRAM error	FU_RC
10DK		WARNING	CAN: Chip DPRAM error & passive	FU_RC
10DL		WARNING	CAN: Unexpected interrupt	FU_RC
10FB	6157066	ERROR	Short circuit detected	FU_RC
10FT		WARNING	Overcurrent detected	FU_RC
10IF		WARNING	Initialization failed	FU_RC
10LA		WARNING	Acceleration count limit exceeded	FU_RC
10LH	6157672	ERROR	Phase current %u mA (>%u)	FU_RC
10LL	6157676	ERROR	Phase current %u mA (<%u)	FU_RC
10LO	6157679	WARNING ERROR	Intermediate voltage %u V (>%u)	FU_RC
10LT	6157684	ERROR	Temperature limit exceeded	FU_RC
10LU	6157685	WARNING ERROR	Intermediate voltage %u V (<%u)	FU_RC
10LZ	6157690	ERROR	Temperature sensor failure	FU_RC
10OE		WARNING	CPU: PXROS error %d	FU_RC
10OF		WARNING	CPU: PXROS error %d %s(%d)	FU_RC
10RC	6158267	ERROR	Rotation check failed	FU_RC
10RI	6158273	ERROR	Invalid rotation request: %u	FU_RC
10RT	6158284	ERROR	Rotation request timeout	FU_RC
10TD	6158468	ERROR	Invalid data for tube %u	FU_RC
10TE	6158469	ERROR	Stator %u hardware error	FU_RC
10TF	6158470	ERROR	Stator %u switching failed	FU_RC
10TI	6158473	ERROR	Invalid stator request: %u	FU_RC
10TR	6158482	ERROR	Stator change with rotating anode	FU_RC
10UI		WARNING	Unknown message from CU: IIM %u	FU_RC
10UM		WARNING	Unexpected message from CU: IIM %u	FU_RC
10WT		WARNING	CPU: Watchdog timeout	FU_RC
10XX		WARNING	IMPOSSIBLE ERROR	FU_RC

1) As it occurs in the error log and within XRGSCOPE.

2) As it occurs on the COCKPIT desk.

2. Errors as they occur on the COCKPIT control desk, in the error trace and in XRGSCOPE, sorted by numerical code.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6106648	00B0	ERROR	CPU: Error in application data service interface	CU
6106657	00B9	ERROR	AD: Message from unknown function unit (FU)	CU
6106680	00BP	ERROR	AD: Unknown message from system controller	CU
6106865	00DA	ERROR WARNING	No CPU-Access to CAN-chip	CU
6106869	00DE	ERROR WARNING	Unexpected CAN-chip int-pointer	CU
6106873	00DI	ERROR	CAN-chip state bus-OFF #1H	CU
6106876	00DL	ERROR	Unexpected CAN-chip interrupt	CU
6106984	00E0	ERROR	iRMX exception #2#1H occurred	CU
6107149	00G1	ERROR	Condition_code <> OK after CALL to send	CU
6107352	00I4	ERROR	One FU has a WD-error	CU
6107449	00J1	ERROR	DI: Unknown IIM #1H	CU
6107450	00J2	ERROR	DI: rx LWDR param out of range FS= #1H PID= #2H	CU
6107451	00J3	ERROR	DI: rx LWDR message corrupted FS= #1H PID= #2H	CU
6107452	00J4	ERROR	DI: Internal table lookup failed FS= #1H PID= #2H	CU
6107454	00J6	ERROR	DI: tx LWDR param error FS= #1H PID= #2H ER= #3H	CU
6107455	00J7	ERROR	DI: LWDR message creation failed	CU
6107466	00JB	ERROR	DI: Unknown LWDR message received FS= #1H	CU
6107467	00JC	ERROR	DI: tx LWDR message size invalid FS= #1H	CU
6107649	00L1	ERROR	GC: Checksum error	CU
6107650	00L2	ERROR	GC: Data access error	CU
6107651	00L3	ERROR	GC: Limit data error	CU
6107652	00L4	ERROR	GC: Limits inconsistent	CU
6107653	00L5	ERROR	GC: Calculation error	CU
6107654	00L6	ERROR	GC: Function not implemented	CU
6107748	00M0	ERROR	Unable to initialize FU(s) #1H, #2H, #3H, #4H, #5H, #6H	CU
6107749	00M1	ERROR	Configuration key is missing or defective	CU
6107751	00M3	ERROR	No response at all from FU(s) #1H, #2H, #3H, #4H, #5H, #6H	CU
6107752	00M4	ERROR	Function value from SE out of range	CU
6107753	00M5	ERROR	Procedure index from SE out of range	CU
6107772	00MH	ERROR	Job incorrectly identified	CU

- 3) As it occurs on the COCKPIT desk.

- 4) As it occurs in the error log and within XRGSCOPE.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6108068	00PD	ERROR	PC comm.: Unknown TDL proc id	CU
6108348	00S0	ERROR	PC comm.: Tube programming error	CU
6108363	00S?	ERROR	PC comm.: Unexpected error	CU
6108365	00SA	ERROR	PC comm.: Not enough space at destination segment	CU
6108367	00SC	ERROR	PC comm.: Value too large	CU
6108368	00SD	ERROR	PC comm.: Terminator not found	CU
610836	00SE	ERROR	PC comm.: Error in description	CU
6108370	00SF	ERROR	PC comm.: Item type unknown	CU
6108371	00SG	ERROR	PC comm.: Internal type unknown	CU
6108372	00SH	ERROR	PC comm.: Value negative	CU
6108374	00SJ	ERROR	PC comm.: Syntax wrong	CU
6108375	00SK	ERROR	PC comm.: String too long	CU
6108378	00SN	ERROR	PC comm.: FU reference table full	CU
6108379	00SO	ERROR	PC comm.: Node ID unknown	CU
6108380	00SP	ERROR	PC comm.: FU code unknown	CU
6108381	00SQ	ERROR	PC comm.: Syntax error in node ID	CU
6108383	00SS	ERROR	PC comm.: Request not performed	CU
6108384	00ST	ERROR	PC comm.: RMX error	CU
6108386	00SV	ERROR	PC comm.: Mail corrupted	CU
6108387	00SW	ERROR	PC comm.: Procedure ID unknown	CU
6108388	00SX	ERROR	PC comm.: FU mA incompatible	CU
6108389	00SY	ERROR	PC comm.: FU OFF request failed	CU
6108390	00SZ	ERROR	PC comm.: Wrong response	CU
6108463	00T?	ERROR	TTS: Unexpected Error	CU
6108465	00TA	ERROR	TTS: Received message unknown	CU
6108466	00TB	ERROR	TTS: Tube supervision error from FU kV	CU
6108467	00TC	ERROR	TTS: Internal TTS error	CU
6108468	00TD	ERROR	TTS: Tube number unknown	CU
6108469	00TE	ERROR	TTS: NVRAM checksum error	CU
6108470	00TF	ERROR	TTS: NVRAM unavailable	CU
6108471	00TG	ERROR	TTS: Tube overheated	CU

3) As it occurs on the COCKPIT desk.

4) As it occurs in the error log and within XRGSCOPE.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6108848	00X0	ERROR	CPU: Wrong timer id	CU
6108849	00X1	ERROR	CPU: Wrong timer mode	CU
6108850	00X2	ERROR	CPU: Wrong message type	CU
6108852	00X4	ERROR WARNING	Timeout of X-ray backup timer	CU
6108873	00XI	ERROR	Init with FU-RoCo not OK	CU
6108874	00XJ	ERROR WARNING	Exposure time too short	CU
6108879	00XO	ERROR	Exposure time too long	CU
6108885	00XU	ERROR	Transition endless loop	CU
6108887	00XW	ERROR	EN_X active in startup	CU
6108888	00XX	ERROR	RD_PR_X stays active after prep	CU
6126567	02AC	ERROR	Wrong index for table access	FU_kV
6126568	02AD	ERROR	Wrong do case entry	FU_kV
6126965	02EA	ERROR	Interrupt 0: Divide by zero	FU_kV
6126966	02EB	ERROR	Interrupt 1: Single step	FU_kV
6126967	02EC	ERROR	Interrupt 2: NMI	FU_kV
6126968	02ED	ERROR	Interrupt 3: Breakpoint	FU_kV
6126969	02EE	ERROR	Interrupt 4: Overflow exception	FU_kV
6126970	02EF	ERROR	Interrupt 5: Array bounds exception	FU_kV
6126971	02EG	ERROR	Interrupt 6: Unused opcode	FU_kV
6126972	02EH	ERROR	Interrupt 7: ESC opcode	FU_kV
6126973	02EI	ERROR	CAN connection to CU lost	FU_kV
6127266	02HB	ERROR	kV nominal value out of range	FU_kV
6127268	02HD	ERROR	Z nominal value out of range	FU_kV
6127270	02HF	ERROR	kV value during standby too large	FU_kV
6127272	02HH	ERROR	kV actual value out of range	FU_kV
6127274	02HJ	ERROR	E value during standby out of range	FU_kV
6127276	02HL	ERROR	E value during high tension out of range	FU_kV
6127278	02HN	ERROR	Converter 1 temperature out of range	FU_kV
6127280	02HP	ERROR	Converter 2 temperature out of range	FU_kV

3) As it occurs on the COCKPIT desk.

4) As it occurs in the error log and within XRGSCOPE.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6127282	02HR	ERROR	High voltage tank temperature out of range	FU_kV
6127284	02HT	ERROR	Divider test cathode out of range	FU_kV
6127286	02HV	ERROR	Divider test anode out of range	FU_kV
6127288	02HX	ERROR	kV asymmetrical	FU_kV
6127765	02MA	ERROR	State request not accepted because of grid mode	FU_kV
6127766	02MB	ERROR	State request not accepted because of error state	FU_kV
6127965	02OA	ERROR	RMX error: Timeout	FU_kV
6127966	02OB	ERROR	RMX error: Memory	FU_kV
6127967	02OC	ERROR	RMX error: Busy	FU_kV
6127969	02OE	ERROR	RMX error: Limit	FU_kV
6127970	02OF	ERROR	RMX error: Context	FU_kV
6127971	02OG	ERROR	RMX error: Exist	FU_kV
6127972	02OH	ERROR	RMX error: State	FU_kV
6127973	02OI	ERROR	RMX error: Not configured	FU_kV
6127974	02OJ	ERROR	RMX error: Interrupt saturation	FU_kV
6127975	02OK	ERROR	RMX error: Interrupt overflow	FU_kV
6127976	02OL	ERROR	RMX error: Transmission	FU_kV
6127977	02OM	ERROR	RMX error: Divide by zero	FU_kV
6127978	02ON	ERROR	RMX error: Overflow	FU_kV
6127979	02OO	ERROR	RMX error: Type	FU_kV
6127980	02OP	ERROR	RMX error: Parameter	FU_kV
6127981	02OQ	ERROR	RMX error: Bad call	FU_kV
6127982	02OR	ERROR	RMX error: Array bound	FU_kV
6127983	02OS	ERROR	RMX error: NDP error	FU_kV
6127984	02OT	ERROR	RMX error: Illegal opcode	FU_kV
6127985	02OU	ERROR	RMX error: Emulator trap	FU_kV
6127986	02OV	ERROR	RMX error: Interrupt table limit	FU_kV
6127987	02OW	ERROR	RMX error: CPU xfer data limit	FU_kV
6127988	02OX	ERROR	RMX error: Wrap around	FU_kV
6127989	02OY	ERROR	RMX error: Check exception	FU_kV
6127990	02OZ	ERROR	RMX error: Unknown	FU_kV

3) As it occurs on the COCKPIT desk.

4) As it occurs in the error log and within XRGSCOPE.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6128565	02UA	ERROR	HW configuration identifier wrong	FU_kV
6128766	02WB	ERROR	Wrong tube selected	FU_kV
6128768	02WD	ERROR	EN X C signal faulty	FU_kV
6128770	02WF	ERROR	Wrong grid mode selected	FU_kV
6128772	02WH	ERROR	Tube arcing detected	FU_kV
6128774	02WJ	ERROR	kV over voltage detected	FU_kV
6128776	02WL	ERROR	Tube supervision error	FU_kV
6128777	02WM	ERROR	Tube supervision error	FU_kV
6136965	03EA	ERROR	CPU interrupt 0	FU_mA
6136966	03EB	ERROR	CPU interrupt 1	FU_mA
6136968	03ED	ERROR	CPU interrupt 3	FU_mA
6136969	03EE	ERROR	CPU interrupt 4	FU_mA
6136970	03EF	ERROR	CPU interrupt 5	FU_mA
6136971	03EG	ERROR	CPU interrupt 6	FU_mA
6136972	03EH	ERROR	CPU interrupt 7	FU_mA
6136973	03EI	ERROR	CAN is unable to send an error to CU	FU_mA
6137067	03FC	ERROR	No NVRAM plugged in	FU_mA
6137165	03GA	ERROR	Limit error	FU_mA
6137265	03HA	ERROR	Unknown hardware	FU_mA
6137266	03HB	WARNING ERROR	Intermediate circuit voltage < 200V	FU_mA
6137272	03HH	ERROR	If setpoint too large	FU_mA
6137273	03HI	ERROR	If-actual out of tolerance	FU_mA
6137274	03HJ	ERROR	If-actual out of tolerance	FU_mA
6137276	03HL	ERROR	If-nominal out of tolerance	FU_mA
6137277	03HM	ERROR	If-nominal out of tolerance	FU_mA
6137278	03HN	ERROR	No retrigger received from CU	FU_mA
6137965	03OA	ERROR	RMX exception: E\$TIME	FU_mA
6137966	03OB	ERROR	RMX exception: E\$MEM	FU_mA
6137967	03OC	ERROR	RMX exception: E\$BUSY	FU_mA
6137968	03OD	ERROR	RMX exception: E\$LIMIT	FU_mA

3) As it occurs on the COCKPIT desk.

4) As it occurs in the error log and within XRGSCOPE.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6137969	03OE	ERROR	RMX exception: E\$CONTEXT	FU_mA
6137970	03OF	ERROR	RMX exception: E\$EXIST	FU_mA
6137971	03OG	ERROR	RMX exception: E\$STATE	FU_mA
6137972	03OH	ERROR	RMX exception: E\$NOT\$CONFIGURED	FU_mA
6137973	03OI	ERROR	RMX exception: E\$INTERRUPT\$SATURATION	FU_mA
6137974	03OJ	ERROR	RMX exception: E\$INTERRUPT\$OVERFLOW	FU_mA
6137975	03OK	ERROR	RMX exception: E\$TRANSMISSION	FU_mA
6137976	03OL	ERROR	RMX exception: E\$ZERO\$DIVIDE	FU_mA
6137977	03OM	ERROR	RMX exception: E\$OVERFLOW	FU_mA
6137978	03ON	ERROR	RMX exception: E\$TYPE	FU_mA
6137979	03OO	ERROR	RMX exception: E\$PARAM	FU_mA
6137980	03OP	ERROR	RMX exception: E\$BAD\$CALL	FU_mA
6137981	03OQ	ERROR	RMX exception: E\$ARRAY\$BOUND	FU_mA
6137982	03OR	ERROR	RMX exception: E\$NDP\$ERROR	FU_mA
6137983	03OS	ERROR	RMX exception: E\$ILLEGAL\$OPCODE	FU_mA
6137984	03OT	ERROR	RMX exception: E\$EMULATOR\$TRAP	FU_mA
6137985	03OU	ERROR	RMX exception: E\$INTERRUPT\$TABLE\$LIMIT	FU_mA
6137986	03OV	ERROR	RMX exception: E\$CPUXFER\$DATA\$LIMIT	FU_mA
6137987	03OW	ERROR	RMX exception: E\$SEG\$WRAP\$AROUND	FU_mA
6137988	03OX	ERROR	RMX exception: E\$CHECK\$EXCEPTION	FU_mA
6137989	03OY	ERROR	Unknown RMX exception	FU_mA
6138065	03PA	ERROR	Ie zero measured	FU_mA
6138067	03PC	ERROR	Ie out of tolerance	FU_mA
6138069	03PE	ERROR	Emergency OFF, grid not closed!	FU_mA
6138070	03PF	ERROR	No kV discharged due to missing Ie	FU_mA
6156765	10CA	ERROR	CAN: Case-selector error	FU_RC
6156767	10CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_RC
6156768	10CD	ERROR	CAN: No RTR from CU	FU_RC
6156769	10CE	ERROR	CAN: rx signal conflict IIM%u	FU_RC
6156770	10CF	ERROR	CAN: tx timeout	FU_RC

3) As it occurs on the COCKPIT desk.

4) As it occurs in the error log and within XRGSCOPE.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6156789	10CY	ERROR	CAN: rx abort IIM%u	FU_RC
6156865	10DA	ERROR	CAN: Chip access error	FU_RC
6156866	10DB	ERROR	CAN: Chip reset error	FU_RC
6156867	10DC	ERROR	CAN: Chip reset release error	FU_RC
6156870	10DF	ERROR	CAN: Chip state undefined	FU_RC
6156874	10DJ	ERROR	CAN: Chip DPRAM Error	FU_RC
6157066	10FB	ERROR	Short circuit detected	FU_RC
6157672	10LH	ERROR	Phase current %u mA (>%u)	FU_RC
6157676	10LL	ERROR	Phase current %u mA (<%u)	FU_RC
6157679	10LO	WARNING ERROR	Intermediate voltage %u V (>%u)	FU_RC
6157684	10LT	ERROR	Temperature limit exceeded	FU_RC
6157685	10LU	WARNING ERROR	Intermediate voltage %u V (<%u)	FU_RC
6157690	10LZ	ERROR	Temperature sensor failure	FU_RC
6158267	10RC	ERROR	Rotation check failed	FU_RC
6158273	10RI	ERROR	Invalid rotation request: %u	FU_RC
6158284	10RT	ERROR	Rotation request timeout	FU_RC
6158468	10TD	ERROR	Invalid data for tube %u	FU_RC
6158469	10TE	ERROR	Stator %u hardware error	FU_RC
6158470	10TF	ERROR	Stator %u switching failed	FU_RC
6158473	10TI	ERROR	Invalid stator request: %u	FU_RC
6158482	10TR	ERROR	Stator change with rotating anode	FU_RC
6176765	07CA	ERROR	CAN: Case-selector error	FU_CIE
6176767	07CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_CIE
6176768	07CD	ERROR	CAN: No RTR from CU	FU_CIE
6176769	07CE	ERROR	CAN: rx signal conflict IIM%u	FU_CIE
6176770	07CF	ERROR	CAN: tx timeout	FU_CIE
6176789	07CY	ERROR	CAN: rx abort IIM%u	FU_CIE
6176865	07DA	ERROR	CAN: Chip access error	FU_CIE
6176866	07DB	ERROR	CAN: Chip reset error	FU_CIE

3) As it occurs on the COCKPIT desk.

4) As it occurs in the error log and within XRGSCOPE.

Error Code ³	Error Code ⁴	Error Class	Error Text	FU
6176867	07DC	ERROR	CAN: Chip reset release error	FU_CIE
6176870	07DF	ERROR	CAN: Chip state undefined	FU_CIE
6176874	07DJ	ERROR	CAN: Chip DPRAM error	FU_CIE
6177668	07LD	ERROR	RC stator 1 readback failed	FU_CIE
6177669	07LE	ERROR	RC stator 2 readback failed	FU_CIE
6177670	07LF	ERROR	RC stator 3 readback failed	FU_CIE
6177672	07LH	ERROR	RC speed set timeout	FU_CIE
6177674	07LJ	ERROR	RC maximal rotation time exceeded	FU_CIE

3) As it occurs on the COCKPIT desk.

4) As it occurs in the error log and within XRGSCOPE.

7.3. Elimination of error numbers

00PL:

The message 00PL (error of the AEC signal) may be a "warning" or an "error". It depends on the disturbance of the AEC signal.

The AEC signal can be measured at pin EZ150 X4 (signal) to EZ150 X3 (see also Z1-6 "Basic interface").

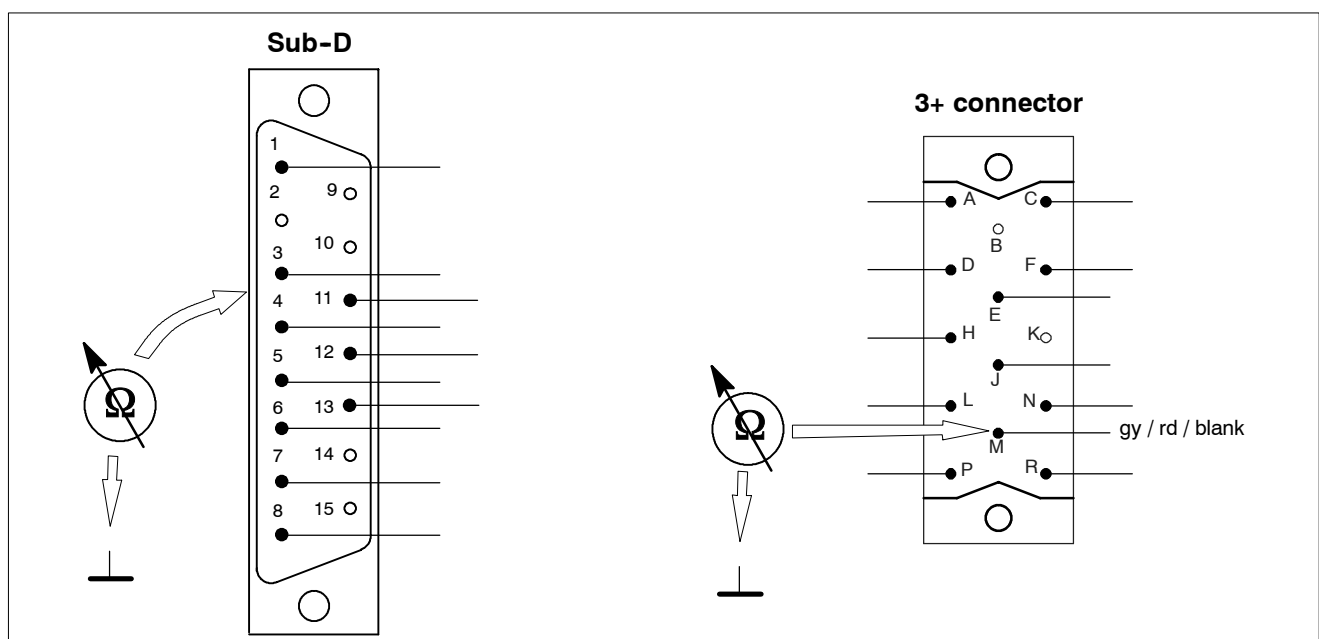
When using measuring chambers there are three possibilities to get the error "00PL":

1. The shielding of the measuring chamber has a connection to system ground at the measuring chamber or interconnection.
2. In the cable to the measuring chamber is a missing ground connection.
(This mistake is not possible with the ACL chamber type No. 9890 000 016xx).
3. The measuring chamber is defective.

Localization and elimination of the error source:

Re 1.)

- Remove the connector of the measuring chamber at the generator side.
- Measure connection:
 - **shielding** (Sub-D connector, 15 pins) to **system ground**
or
 - pin **M** (3+ connector, 14 pins) to system ground ==> **The connection must not be present!**
- Measure connection:
 - **shielding** (Sub-D connector, 15 pins) to **chamber shielding**
or
 - pin **M** (3+ connector, 14 pins) to chamber shielding ==> **The connection must be present!**



Re 2.)

The connector of the measuring chamber at the generator side has been removed.

- Measure the connection between pin **8** and pin **13** (Sub-D connector).

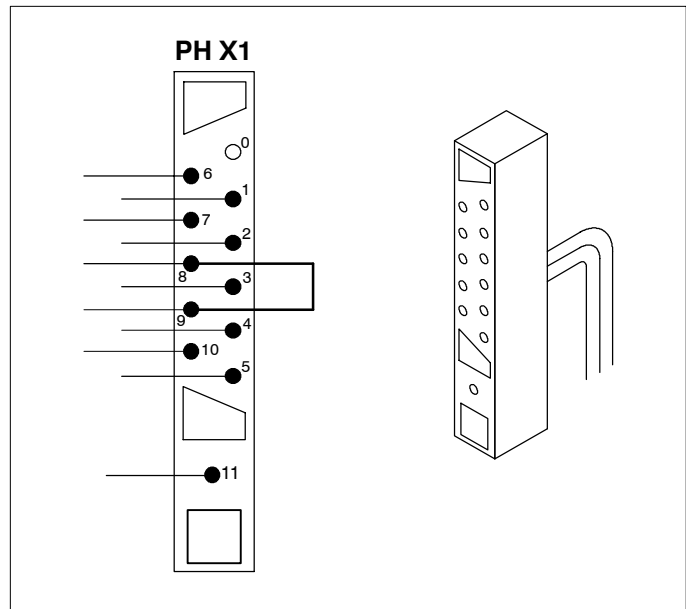
The connection must be present!

- If the connection is not present, insert a link between pin **8** and **9** at the chamber connector at the chamber end as shown in the figure.

In this case the system is most probably operated with an old hybrid measuring chamber 9803 509 xxxxx instead of an ACL measuring chamber 9890 000 016xx. In hybrid measuring chambers the connection between pin **8** <-> **9** is missing.

In case a 3+ connector is used, the connection pin **N** <-> **J** is most probably missing because this connection is not present in hybrid measuring chambers.

To increase interference protection establish the above mentioned connection at the chamber connector of the chamber cable pin **8** <-> **9** in addition to the connection in the adapter for the AMPLIMAT cable (see Z1 "Basic interface").

Re 3.):

Use a test chamber and compare the function.

8. Power supply



Warning!

During fault finding within the power supply unit be very careful the unit is still connected to the mains.

8.1. Switch ON not possible

- ENF1 not switched ON (visual check)
- ENF1 released
 - check for damage before reactivating ENF1/2 (visual check, any smell?)
- ENF2 not switched ON (visual check)
- ENF2 released by

low-voltage supply	}	• check for damage before reactivating ENF1/2 (visual check, any smell?)
filament circuit		
tube extension		
external components supply		
- ON circuit EN100 defective

Phase supervision:

1. Without mains adaptation transformer

- Phase L1 is missing: Mains contactors ENK2 and ENK1 cannot be activated.
- Phase L2 is missing: The generator can be switched ON but does not go into the READY state.
The filament-circuit supply is missing.
There is an error message from function unit kV.
- Phase L3 is missing: ON circuit without supply voltage.
- Fault tracing:
Check leads and fuses up to the mains supply.

2. With mains adaptation transformer

- In case at least one phase at the primary end is missing, the generator cannot be switched ON. If there is a problem concerning the leads at the secondary end, refer to section 1 "INTRODUCTION AND TECHNICAL DATA".

8.2. After switch ON or attempted switch ON

The generator cannot be brought into the READY state (e.g. no desk display).

- Check the low-voltage supply.
- Check for released ENF1:
Ground fault / short-circuit of one / several phase(s).
Check ENK2 and, if necessary, the contacts of ENK1.
Check the leads and the mains adaptation transformer.
Check visually whether the contacts of ENK2 or ENK1 have dropped out.
- Check for missed voltage of intermediate-circuit:
The damping resistors are unsoldered which was caused by overcurrent during switch ON.
Cause: Short-circuit in the converter, defective charging capacitors, mains-filter capacitors or rectifiers.
Unsoldering happens about 45s after switch ON.

The damping resistors are unsoldered because the converter was active and ENK1 was not switched ON although activated by the software.

Probably termination of exposure.

This procedure can only happen once because the generator cannot go into STANDBY mode when intermediate-circuit voltage E is missing.

In case intermediate-circuit voltage E is present, ENK1 is activated by the software of the kV-control and remains activated for the complete time the unit is in operation.

In case of high impedance or the tolerance of the symmetry resistors of the intermediate-circuit capacitor battery is too large, capacitors may be destroyed by overvoltage. In case ENK1 has already been activated, ENF1 probably releases.

ENF3 is released by the rotor control units.

The release of ENF2 switches the generator OFF because the supply voltage for the ON circuit and, consequently, the supply voltage of contactors ENK2 and ENK1 is interrupted.

A converter test kit OPTIMUS is available to determine possible problems with the converter, the HT transformer or the tube.

Order no.: 4512 104 9168x

9. Functional description of function unit mA

Tube data must be loaded as a data set from floppy disk via PC and central unit CU into function unit mA.

The procedures described below cannot be carried out before the complete data set for the tube housing assembly is present in central unit CU.

Before the tube adaptation can be started, tube conditioning must be implemented as described in section 2, chapter 8.3.1.

Before adaptation is started, the mA offset value of the mA measuring circuit has to be determined.

This offset value consists of two components:

1. A current of 4mA is impressed upon the mA measuring circuit which is used for continuous calibration (during STANDBY about once per minute).
2. Additionally the kV measuring circuit delivers an offset current depending on the kV.

To measure this total value an exposure is released with 40kV and 500mA filament current. The emission current measured is the correction value for all standard exposures (4mA, measuring circuit current depending on the kV).

As opposed to the standby filament current value of the predecessor versions of generators, the standby filament current value of the Optimus generator is not fixed.

It is determined for each focus individually. A 40kV exposure is released with the focus to be measured while all other foci are switched OFF.

The filament current changes until an emission current of 100 μ A is obtained.

The associated filament current value is the individual standby filament current (1% to be subtracted so that the fluoroscopic current of any of the other foci is not affected).

The following adaptation program takes place fully automatically.

Based on 120 single exposures for each focus a data field is created in the CMOS of function unit mA. The adjustments for all other exposures are interpolated from this data field during operation.

During the adaptation procedure all limit values such as maximum filament current, maximum kV, maximum tube load, maximum output, current of the generator etc. are taken into account.

Boost adaptation

Boost time determination: Positive boosting

With the predecessor versions of generators, a calculated boost current was added to the exposure filament current for a fixed time of 400ms.

With Optimus generators the boost current is always fixed but with a variable time.

The amount of the boost current is the sum of the maximum filament current (of the respective filament) plus 2000mA.

To determine the time values an exposure must be started at a kV stage from which on the filament current does not have to be increased anymore to obtain the max. kV dependent emission current.

As soon as the 100% kV value is reached, the filament current jumps from the STANDBY value to the maximum filament current plus 2000mA. The emission current is measured every 2ms until the maximum tube current or the maximum possible tube current is reached.

In case this procedure takes too long (warming up of the tube), the measurement is continued with a second exposure after a sufficient period of time has passed.

The measurement starts again at the value obtained last.

Boost time determination: Negative boosting

An innovation of the Optimus generator is the determination of the negative boosting (blanking of the filament current).

The measurement is started at the same kV stage as for the positive boost time but with maximum filament current.

As soon as the 100% kV value is reached, the maximum filament current of the filament jumps down to 500mA.

Every 2ms the emission current is measured until a value of 100µA is obtained.

The values for the blanking times are required for techniques such as, for instance, cine.

A filament current value of 500mA must not be exceeded for otherwise the output to supply a gridswitch box (which might be present) is too low.

The following procedure takes place after the generator has been switched ON:

Function unit mA initializes itself and afterwards establishes connection with central unit CU via CAN.

For 3s every focus is boosted with the respective specified maximum filament current. Then blanking of the filament current (500mA) takes place for a variable period of time (derived from negative boost adaptation) to bring the filament current to the STANDBY value (large focus first followed by a smaller one).

The change of the filament current value upon a change of the focus which was the usual routine for the predecessor versions of the Optimus generator does no longer take place. All STANDBY values remain constant.

During operation the following procedure takes place after the release of PREPARATION:

The filament current rises from the individual STANDBY filament current to the boost current.

The switch ON time of the boost current depends on the difference between STANDBY and the exposure (single boost) or intermediate filament (double boost) current.

Double boost

- The intermediate filament current is a calculated value. It is calculated in such a way that the filament current and thus the filament temperature is brought to exposure level when the boost current is switched ON for another 50ms by the exposure command.
- During exposure the filament current regulates as required.
- At the end of exposure the filament current is reduced to the minimum value of 500mA (negative boosting) for a calculated time to bring it from the exposure to the STANDBY value.
- In case PREPARATION is released, negative boosting takes place until heating can go on with the STANDBY filament current.

10. CAN bus

All the intelligent assemblies and PCBs communicate via the CAN bus. There they are connected in parallel to the two lines CAN_L (low) and CAN_H (high).

The data are serially transmitted in the form of so-called frames.

Levels in quiescent status against chassis:

CAN_L: 2.5V

CAN_H: 2.5V

Levels during data transmission against chassis:

CAN_L: 0.50 ... 2.25V } Both levels are opposite.
CAN_H: 2.75 ... 4.50V } The difference must be > 1.5V!

Test points generator CAN		Test points system CAN	
CAN_L:	EZX71	S_CAN_L:	EZX42:2
CAN_H:	EZX72	S_CAN_H:	EZX42:7
Chassis:	EZX5	Chassis:	EZX42:3

Reference: Z1-5.1, Z2-5.x

Symptoms of errors:

- The generator is inoperable.
- The red LEDs of one or more of the assemblies or PCBs flash.
- Parameter settings at the control desk are accepted and displayed with a considerable delay.
- In the error memory are several entries which code begins with 00C (apart from 00CJ) or the error description contains a reference to signal conflicts.

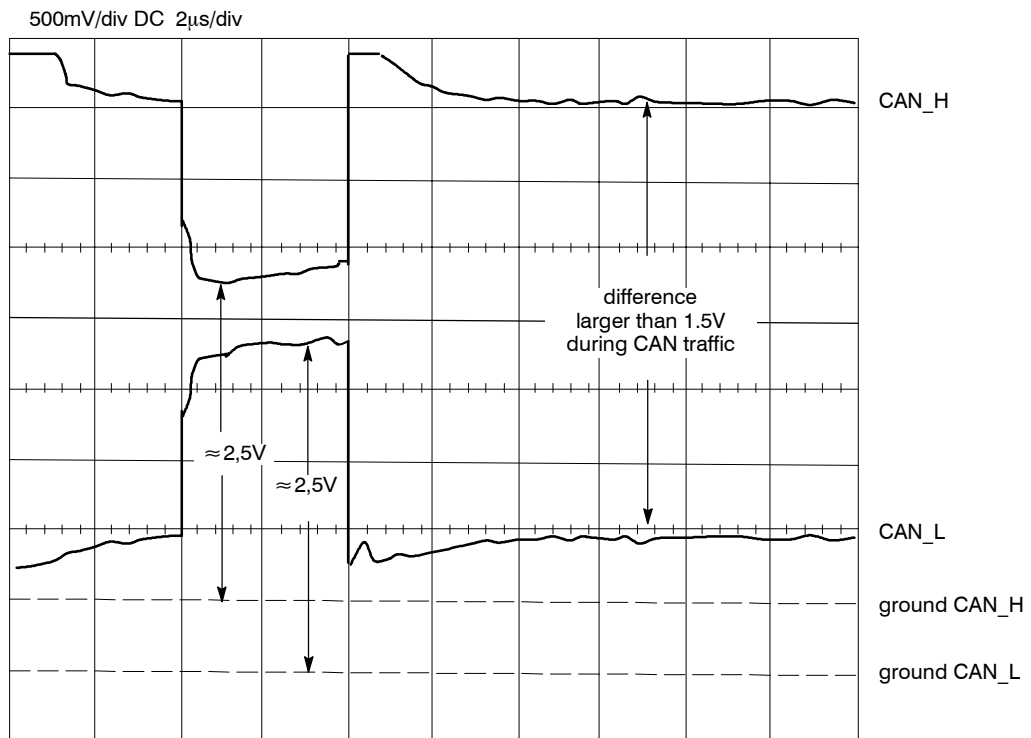
Error localization:

1. Entries in the error memory clearly indicate that the assembly and PCB are not communicating properly or not at all.
2. Control measurement of CAN levels with an oscilloscope during data transmission and in the quiescent status:
Data transmission is triggered by pressing any desk button.
If the levels are outside the tolerance or are not symmetrical, the CAN driver of an assembly or PCB is faulty.
Because all the users are connected to the bus in parallel, the troublemaker can only be found by disconnecting one user after another.

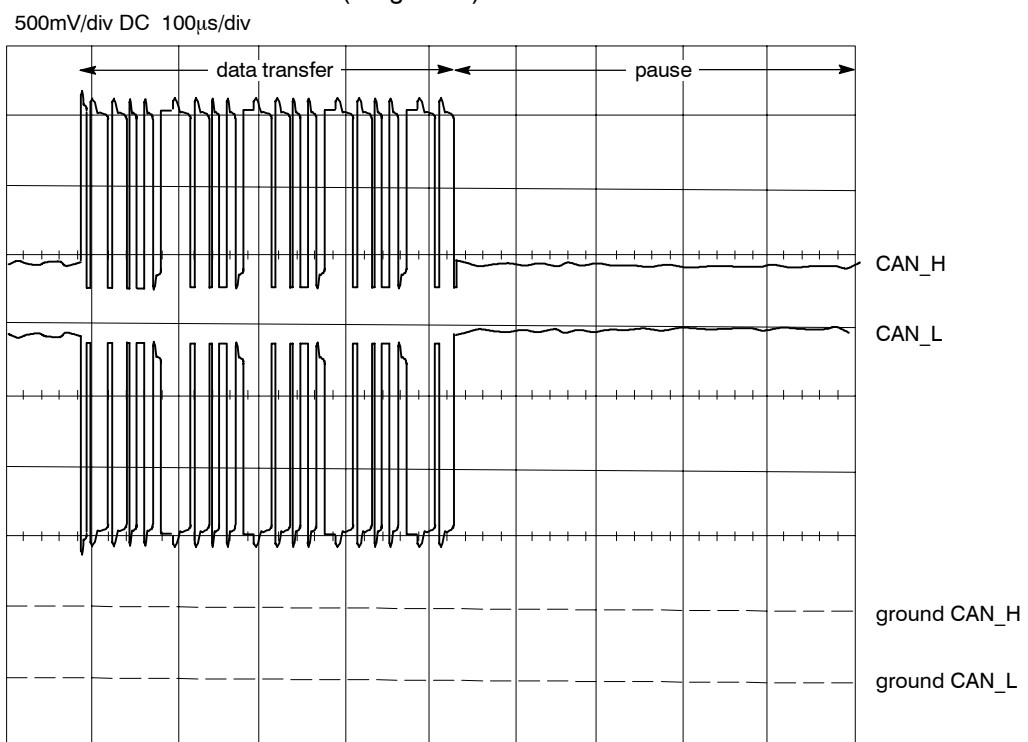
Caution!

Disconnection must only take place with the generator switched OFF.

CAN levels with a high temporal resolution:
(Diagram 1)



CAN levels with low temporal resolution:
(Diagram 2)



197H96

11. Incorrect exposure indicator

General causes:

An incorrect exposure is indicated on the control desk if an exposure cannot be terminated according to the parameters set. Frequent causes of underexposure are the following:

1. The operator lets go of the release switch prematurely.
2. The measuring chamber is incorrectly programmed, not connected or faulty.

Check the following:

- Programming of Amplat sensitivity
- Programming of EZ150 basic interface (gain, 15V/40V-supply)
- Programming of screen/film combination (data set 1 ... 5)

Fault exposure detection AEC / TDC:

To protect patients there are 3 monitoring systems for automatic techniques:

1. Maximum mAs product: Can be set by XRGSCOPE
2. Maximum exposure time or backup time: Can be set by XRGSCOPE
3. Fault exposure detection: The fault exposure detection can be switched ON or OFF via XRGSCOPE. Irrespective of this fault exposure detection does not perform if levels fall below certain limits.

AEC / AECF limits:

- Maximum mAs product: 580mAs (default)
- Maximum exposure time: 4s (cannot be changed)
- Backup time AEC: Exposure time based on 9.5 times the mAs of the respective manual technique (kV-mAs). 4s after overriding
- Backup time AECF: 9.5 times the exposure time of the respective manual technique (kV-mAs)
- Fault exposure detection: $\leq 4\%$ dose at 10% backup time

Fault exposure detection is ignored under the following circumstances:

- Backup time: $\leq 100\text{ms}$ ($\leq 10\text{ms}$ at 10%)
- Switch OFF voltage (dose): $\leq 610\text{mV}$ ($\leq 24.4\text{mV}$ at 4%)

If there is a fault an exposure is aborted after about 10% of backup time. If the fault exposure detection fails to respond in the event of a fault, shutdown takes place after reaching backup time, max. exposure time or max. mAs product.

TDC limits:

- Maximum mAs product: 580mAs (default)
- Exposure time: 0.3 ... 6s
- Fault exposure detection: $\leq 10 \dots 4\%$ dose for 9.5 times the sample time

$$\text{dose minimum} = \frac{9.5 \times \text{sample time}}{\text{exposure time (corr.)}} \times 40\% \text{ nominal dose}$$
- Backup time: Exposure time
- Sample time: 25 ... 60ms = 1% exposure time (corr.); min. 25ms
- Sample steps: 12 ... 100

Fault exposure detection is ignored under the following circumstances:

- Exposure time: < 1s

In the event of a fault the exposure is aborted after approx. 11 times sample time. If the fault exposure detection fails to respond in the event of a fault, shutdown takes place after reaching the backup time or the max. mAs product. The switch OFF voltage should be at least 1.2V to guarantee good TDC regulation. Program the higher gain factor on EZ150 BASIC INTERFACE ($\geq 4512\ 108\ 05964$), if necessary.

Programming possibilities:

- Select menu:
PROGRAM/ APPLICATION LIMITS/ **X-MODE LIMITS**

X-Ray Mode: AEC ... TDC
Max. Current Time Product Limit: 580mAs
- Select menu:
PROGRAM/ DOSE RATE CONTROL/ FAULT EXPOSURE DETECTION/ **AEC ... TDC**

ON - OFF

Aids to fault finding:

- Select menu:
FAULTFIND/ LOGGING TABLE/ X-RAY LOG/ DOSE RATE CONTROL LOGGING/ ...
- ... **READ ACTUAL STATUS** Technique and parameters of the last exposure
- ... AEC/ **AEC CALCULATION** Data of the selected APR with AEC or AECF
- ... AEC/ **AEC TRACE** Control values of the last AEC exposure
- ... TDC/ **TDC CALCULATION** Data of the selected APR with TDC
- ... TDC/ **TDC TRACE** Control values of the last TDC exposure

Adjustment possibilities:

- Select menu:
ADJUST/ DOSE RATE CONTROL/ **TDC AMPLIMAT**

P gain factor	(def. 50):	} Do not change any value here without order from DMC Hamburg!
i gain factor	(def. 8):	
d gain factor	(def. 5):	

min. sample time (def. 40) [ms]: 25 ... 65

12. Mnemonic and routing list

Explanation:

MNEMONIC

explanation

signal chain (-direct connection = connection via relay contact) all possible units mentioned

signal value / range / signal source

measuring point (in () at PCB front panel)

trigger point [preferred]

remarks

part of supply

AC_0V_XG

AC mains supply 0 V X-ray generator

ENX1101/2-EZX13:2-EZ102X1:DBZ4-EZ119X1:DBZ24 Optimus RAD

ENX3201-EZX13:2-EZ102X1:DBZ4-EZ119X1:DBZ24 Optimus R/F

neutral N of mains supply for EZ102 + EZ119

AC_230V_L1

AC mains supply 230VAC phase 1

ENF2:L1-ENF2:T1-ENK2:2-ENK2:1-EZX13:1-EZX102X1:DBZ2

AC mains supply for low voltage power supply EZ102

AC_230V_L2

mains supply 230V AC phase 2

ENF2:L2-ENF2:T2-ENK2:4-ENK2:3-EZX13:3-EZ119X1:DBZ26

AC mains supply for function unit mA_control EZ119

AV_HT_AN

high tension actual value anode side

0V ... +3.75V = 0 ... 75kV 1V = 20kV

measuring point EZ130 (X4)

[CRTL_X_C/ at EZX74]

AV_HT_CA

high tension actual value cathode side

0V ... +3.75V = 0 ... 75kV 1V = 20kV

measuring point EZ130 (X5)

cathode value also positive!

[CRTL_X_C/ at EZX74]

AV_HT

high tension actual value

0 ... +7.5V = 0 ... 150kV 1V = 20kV

measuring point EZ130 (X3)

[CRTL_X_C/ at EZX74]

CAN_H

generator CAN high active

-EZ119X2:C3-EZ130X2:C3-EZ139X2:C3-EZ150X2:C3-EZX44:10-EZX45:10-EZX46:10

-C300X1:10-EZX51:3-EZX151:3-EZX52:7-EZX72

-EWAX51:10-EWAX52:10-EWA100X2:C3-EWBX51:10-EWBX52:10-EWB100X2:C3

+2.5VDC standby, +3.2VDC during communication

EZ72

for communication of generator function units only

part of: XRG bus

CAN_L

generator CAN low active

-EZ119X2:A3-EZ130X2:A3-EZ139X2:A3-EZ150X2:A3-EZX44:2-EZX45:2-EZX46:2

-C300X1:2-EZX51:2-EZX151:2-EZX52:2-EZX71-EWAX51:2-EWAX52:2-EWA100X2:A3-EWBX51:2

-EWBX52:2-EWB100X2:A3

+2.5VDC standby, +1.5VDC during communication

EZ71

for communication of generator function units only

part of: XRG bus

CM_EX_SW_1

common for exposure switch of release decade 1

EWA100X1:C5-EWAX1:10

EWB100X1:C5-EWBX1:10

+26V non-active

exposure request

CM_EX_SW_2

common for exposure switch of release decade 2

EWA100X1:C7-EWAX2:10

EWB100X1:C7-EWBX2:10

+26V non-active

exposure request

CM_EX_SW_3

common for exposure switch of release decade 3

EWA100X1:C9-EWAX3:10

EWB100X1:C9-EWBX3:10

+26V non-active

exposure request

CM_EX_SW_4

common for exposure switch of release decade 4

EWA100X1:C11-EWAX4:10

EWB100X1:C11-EWBX4:10

+26V non-active

exposure request

CM_SW

common for radiation indication

EZ150X1:C29-EZX1:6-EWGX1:6-EWGX2:6-EWGX3:6

partner of SW_UN_EX, potential free contact

CM_TH

common for thermal sensor of tube housing

NTC temperature measurement in tube housing (not yet available)

EZ130X1:C12-EZX3:7-EWGX7:7-EWGX8:7-EWGX9:7

backpanel 4512 108 05983

EZ130X1:C12-EZX3:4-EWGX7:4-EWGX8:4-EWGX9:4

backpanels 4512 108 05984 + 4512 108 09361/2

partner of TH_OL

CM_TH_SW

common for tube housing temperature switch

EZ130X1:C11-EZX3:4-EWGX7:4-EWGX8:4-EWGX9:4

backpanel 4512 108 05983

EZ130X1:C11-EZX3:7-EWGX7:7-EWGX8:7-EWGX9:7

backpanels 4512 108 05984 + 4512 108 09361/2

partner of TH_OL_SW/

COM_EX_CD

common for exposure end signal and other warning signals

EWB102X1:A12-EWBX22:6

partner of EX_CD + SW_XG_RD_1 + SW_PR_FL_1 + SW_WN_FL_1 + SW_UN_EX_1

CTRL_X/

control X-ray request command, system level or with decade adaptation units WA/WB

EZ139X1:A4-EZX23:4-EZX45:5-EWAX51:5-EWAX52:5-EWA100X2:C25-EWBX51:5-EWBX52:5
-EWB100X2:C25

0V active, +15V inactive

EZX85

part of: signal bus

CTRL_X_C/

control X-ray request command, internal generator signal

EZ119X2:C6-EZ130X2:C6-EZ139X2:C6-EZ150X2:C6-EZX52:8

0V active, +5V inactive

EZX74 as preferred trigger signal for kV measurement

final high tension on command if all conditions ready

part of: XRG bus, CAN/XS bus

CU_CT1_1

cooling unit contact 1_1

EZ150X1:A22-EZX2:6-EWGX4:6-EWGX5:6-EWGX6:6

CU_CT1_2

cooling unit contact 1_2

EZ150X1:C22-EZX2:7-EWGX4:7-EWGX5:7-EWGX6:7

CU_U

stator current U

high speed rotor control units 4512 104 71421/461

EY100 X15

9.3A/V

CU_V

stator current V

high speed rotor control units 4512 104 71421/461

EY100 X16

9.3A/V

CU_W

stator current W

high speed rotor control units 4512 104 71421/461

EY100 X17

9.3A/V

CV1 EN/

CV2 EN/

converter 1/2 enable

converter 1: EZ130X1:A9-EZX24:22-EQ100X1:22

converter 2: EZ130X1:A30-EZX34:22-E2Q100X1:22

not used, no function

CV1_GND

converter power part 1 ground

EZ130X1:AC8-EZX24:8/21-EQ100X1:8/21

in combination with: CV2_ID/ signal release 2 generators

in combination with: CV2_IDA/ and CV2_IDB/ release 3 generators

CV1_GND_OL

converter power part 1 ground overload (generator basic version \geq 4512 104 70203/70602)

EZ130X1:A7-EZX24:20-EQ100X1:20

not used, no function

CV1_ID/

converter power part 1 identification

EQ100X1:19-EZX24:19-EZ130X1:A6

open +5V, converter connected 0V

in combination with: CV1_GND signal

release 2 generators only

CV1_IDA/

converter power part 1 identification A

EQ100X1:19-EZX24:19-EZ130X1:A6

open +5V, converter connected +24mV

in combination with: CV1_GND signal

release 3 generators only

CV1_IDB/

converter power part 1 identification B
 EQ100X1:21-EZX24:21-EZ130X1:C9
 open +5V, converter connected +24mV
 in combination with: CV1_GND signal
 release 3 generators only

CV2_IDA/

converter power part 2 identification A
 E2Q100X1:19-EZX34:19-EZ130X1:A27
 open +5V, converter connected +24mV
 in combination with: CV2_GND signal
 release 3 generators only

CV2_IDB/

converter power part 2 identification B
 E2Q100X1:21-EZX34:21-EZ130X1:C30
 open +5V, converter connected +24mV
 in combination with: CV2_GND signal
 release 3 generators only

CV1_OL/

converter power part 1 overload
 EQ100X1:7-EZX24:7-EZ130X1:C7
 not used, no function

CV1_TM

converter power part 1 temperature
 EQ100X1:6-EZX24:6-EZ130X1:C6
 4.4V ... 1.5V = 20 ... 100 degrees C
 in combination with: CV1_GND signal

CV2_GND

converter power part 2 ground
 EZ130X1:AC29-EZX34:8/21-E2Q100X1:8/21
 in combination with: CV2_ID/ signal release 2 generators
 in combination with: CV2_IDA/ and CV2_IDB/ release 3 generators

CV2_GND_OL

converter power part 2 ground overload (generator basic version ≥ 4512 104 70203/70602)
 EZ130X1:A28-EZX34:20-E2Q100X1:20
 not used, no function

CV2_ID/

converter power part 2 identification
 E2Q100X1:19-EZX34:19-EZ130X1:A27
 open +5V, converter connected 0V
 in combination with: CV2_GND signal
 release 2 generators only

CV2_OL

converter power part 2 overload

E2Q100X1:7-EZX34:7-EZ130X1:C28

not used, no function

CV2_TM

converter power part 2 temperature

EZ130X1:C27-E2Q100X1:6-EZX34:6

4.4V...1.5V = 20...100 °C

in combination with: CV2_GND signal

DR_BV_0V

dose rate (signal) reference of image intensifier

EZX61:3-EZ139X2:C18

backpanel 4512 108 05983/4 only

negative potential of II unit, 0V +/-50mV against generator ground

differential signal with DR_BV_SG

not used, no function for generators release 2

DR_BV_NG

dose rate (signal) reference of image intensifier

EZX61:6-EZ139X2:C18

backpanel 4512 108 09361/2 only

negative potential of II unit, 0V +/-50mV against generator ground

differential signal with DR_BV_SG

part of: dose rate control

DR_BV_SG

dose rate signal of image intensifier

EZX61:8-EZ139X2:A18

backpanel 4512 108 05983/4 only

EZX61:4-EZ139X2:A18

backpanel 4512 108 09361/2 only

positive potential, 0 ... 10V

differential signal with DR_BV_NG

no function for generators release 2

part of: dose rate control

DR_FL_LO_1

dose rate fluoro lock-in 1

EWBX12:7-EWB100X1:A21

DR_FQ_NG

dose rate signal (pulses) negative

not used, no function

DR_FQ_PO

dose rate signal (pulses) positive

not used, no function

DR_LM

dose rate limiter

EWBX12:1-EWB100X1:A20

low_active if tubelift D76 / EZD on short SID (if tubelift option present)

DR_TV_NG

dose rate of TV chain signal negative, fluoro control
(II/TV_adapter_PCB_X3:1-X2:8)-EZ61:8-EZ139X2:C19
+/-12V minus polarity
dual voltage differential signal
typically +6V in standby coming from TV chain
+V for more dose, -V for less dose, 0V stable image
part of: dose rate control

backpanel 4512 108 09361/2

DR_TV_NT

dose rate of TV chain signal negative, fluoro control
EZ61:4-EZ139X2:C19
not used, no function

backpanel 4512 108 05983/4

DR_TV_PO

dose rate of TV chain signal positive, fluoro control
(II/TV_adapter_PCB_X3:3-X2:7)-EZ61:7-EZ139X2:A19
-/+12V positive polarity
dual voltage differential signal
typically -6V in standby coming from TV chain
-V for more dose, +V for less dose, 0V stable image
part of: dose rate control

backpanel 4512 108 09361/2

DR_TV_PT

dose rate of TV chain signal positive, fluoro control
EZ61:9-EZ139X2:A19
not used, no function

backpanel 4512 108 05983/4

DS_BV_NG

dose (signal ramp) reference of image intensifier
(II/TV_adapter_PCB_X1:P-X2:3)-EZ61:3-EZ139X2:C17
negative potential of II unit, 0V +/-50mV against generator ground
differential signal with DS_BV_SG
part of: dose rate control

backpanel 4512 108 09361/2

DS_BV_0V

dose (signal ramp) reference of image intensifier
EZ61:2-EZ139X2:C17
not used, no function

backpanel 4512 108 05983/4

DS_BV_SG

dose signal ramp of image intensifier signal
EZ61:7-EZ139X2:A17
(II/TV_adapter_PCB_X1:R-X2:2)-EZ61:2-EZ139X2:A17
0 ... 10V, polarity positive
differential signal with DS_BV_NG release 3 generators only
release 2 generators: not used, no function
part of: dose rate control

backpanel 4512 108 05983/4

backpanel 4512 108 09361/2

DS_MC_0V

dose (signal ramp) reference of selected measuring chamber

EZ150X2:C16-EZ139X2:C16

negative potential of selected measuring chamber, 0V +/-50mV against generator ground

differential signal with DS_MC_SG

DS_MC_SG

dose signal ramp of selected measuring chamber

EZ150X2:A16-EZ139X2:A16

0 ... +12V

[EZ150 X4 against X5 ground]

differential signal with DS_MC_0V

E_NG_CV1

E value converter DC supply negative

converter 1 (frontal 50/65/80kW): EQ100X1:5-EZX24:5-EZ130X1:C5

0 ... -12V = 0 ... -375V if converter is stand-alone (EQ100 X1 not connected)

if in normal operation: $E_PO + E_NG \gg 445VDC = 10V$ measuring input EZ130 X1:A5 - X1:C5

E_NG_CV2

E value converter DC supply negative

converter 2 (rear 65/80kW): E2Q100X1:5-EZX34:5-EZ130X1:C26

no input to EZ130 release 2 generators

release 3 generators only with 2 converters

0 ... -12V = 0 ... -375V if converter is stand-alone (E2Q100 X1 not connected)

if in normal operation: $E_PO + E_NG \gg 445VDC = 10V$ measuring input EZ130 X1:A26 - X1:C26

E_PO_CV1

E value converter DC supply positive

converter 1: EQ100X1:18-EZX24:18-EZ130X1:A5

0 ... +12V = 0 ... +375V if converter is stand-alone (EQ100 X1 not connected)

if in normal operation: $E_PO + E_NG \gg 445VDC = 10V$ measuring input EZ130 X1:A5 - X1:C5

E_PO_CV2

E value converter DC supply positive

converter 2: E2Q100X1:18-EZX34:18-EZ130X1:A26

no input to EZ130 version 4512 108 08661..4 release 2 generators

release 3 generators only with 2 converters EZ130 version 4512 108 09102 ... 4

0 ... +12V = 0 ... +375V if converter is stand-alone (E2Q100 X1 not connected)

if in normal operation: $E_PO + E_NG \gg 445VDC = 10V$ measuring input EZ130 X1:A26 - X1:C26

EN_X/

enable X-ray, system level

preparation or fluoro request, only valid in combination with CAN message (RAD-R/F)

or hardware requests (Optimus C)

EZ139X1:C2-EZX10:1/3-EZX23:15-EZX45:11-EZX46:11-C300X1:11-EWAX51:11-EWAX52:11

-EWA100X2:C26-EWBX51:11-EWBX52:11-EWB100X2:C26

measuring point: EZX82, EZ139X9

part of: signal bus

0V/+15V low active

EX_CD

exposure end signal
contact to drive e.g. an external buzzer
partner of COM_EX_CD

EN_X_C/

enable X-ray, internal generator signal
preparation or fluoro request if confirmed by CAN message (RAD-R/F)
or hardware requests (Optimus C)
EZ119X2:C7-EZ130X1:C7-EZ130X2:C7-EZ139X2:C7-EZ150X2:C7-EZX52:9-EZX76
0V/+5V low active
measuring point EZX76
driven by CU if EN_X/ active (low)
part of: XS/XRG bus

EX_ON

exposure on
EWA100X2:A9-EWAX14:7
EWB100X2:A9-EWBX14:7
potential free optocoupler driven signal
in combination with IT_0V
supply: max 26V 10mA
part of: EXON old world

FD_C_CH1

central field measuring chamber 1
EZ150X1:C4-EZX21:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH2

central field measuring chamber 2
EZ150X1:A4-EZX22:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH3

central field measuring chamber 3
EZ150X1:C10-EZX31:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH4

central field measuring chamber 4
EZ150X1:A10-EZX32:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH5

central field measuring chamber 5
EZ150X1:C16-EZX41:12
+15V, Ri of EZ150 = 220Ω

FD_L_CH1

left field measuring chamber 1

EZ150X1:C3-EZX21:11

+15V, Ri of EZ150 = 220Ω

FD_L_CH2

left field measuring chamber 2

EZ150X1:A3-EZX22:11

+15V, Ri of EZ150 = 220Ω

FD_L_CH3

left field measuring chamber 3

EZ150X1:C9-EZX31:11

+15V, Ri of EZ150 = 220Ω

FD_L_CH4

left field measuring chamber 4

EZ150X1:A9-EZX32:11

+15V, Ri of EZ150 = 220Ω

FD_L_CH5

left field measuring chamber 5

EZ150X1:C15-EZX41:11

+15V, Ri of EZ150 = 220Ω

FD_R_CH1

right field measuring chamber 1

EZ150X1:C5-EZX21:3

+15V, Ri of EZ150 = 220Ω

FD_R_CH2

right field measuring chamber 2

EZ150X1:A5-EZX22:3

+15V, Ri of EZ150 = 220Ω

FD_R_CH3

right field measuring chamber 3

EZ150X1:C11-EZX31:3

+15V, Ri of EZ150 = 220Ω

FD_R_CH4

right field measuring chamber 4

EZ150X1:A11-EZX32:3

+15V, Ri of EZ150 = 220Ω

FD_R_CH5

right field measuring chamber 5

EZ150X1:C17-EZX41:3

+15V, Ri of EZ150 = 220Ω

FI_TF1_1

filament transformer 1 line 1

EZ119X1:DBZ4-EZX12:1-EG106X15:1

square pulses 100 ... 20kHz, amplitude ~ 300V

FI_TF1_2

filament transformer 1 line 2

EZ119X1:DBZ6-EZX12:2-EG106X15:2

square pulses 100 ... 20kHz, amplitude ~ 300V

FI_TF2_1

filament transformer 2 line 1

EZ119X1:DBZ8-EZX12:4-EG106X15:4

square pulses 100 ... 20kHz, amplitude ~ 300V

FI_TF2_2

filament transformer 2 line 2

EZ119X1:DBZ10-EZX12:5-EG106X15:5

square pulses 100 ... 20kHz, amplitude ~ 300V

GND

ground

-EZ102X1:DBZ6-EZ119X1:DBZ26-EZ102X2:DBZ8/10/12/14/16/18/20/26/30-EZ119X2:AC4/5/13/15/16/32
 -EZ130X2:C16:AC4/5/13/15/32-EZ139X2:AC4/5/13/15/32-EZ150X2:AC4/5/13/15/32-EZX21:13
 -EZX22:13-EZX31:13-EZX32:13-EZX41:13-EZX12:3/6-EZX51:11/12/13/14/15-EZX151:X11/12/13/14/15
 -EZX44:1/7-EZX46:8/13-EZX1:9-EZX2:10-EZX3:10-EZX5-EZX6-EZX7:3-EZX8:3-EZX17:2-EZX18:2
 -EZX19:2-EZX20:2
 -EWGX11:4-EWGX12:4-EWGX1:9-EWGX2:9-EWGX3:9-EWGX4:10-EWGX5:10
 -EWGX6:10-EWGX7:10-EWGX8:10-EWGX9:10
 -EWAX41:2-EWAX42:2-EWAX51:15-EWAX52:15
 -EWAX1:7-EWAX2:7-EWAX3:7-EWAX4:7-EWAX11:2-EWAX11:4-EWAX11:6-EWAX11:9-EWAX12:2
 -EWAX12:4-EWAX12:6-EWAX12:9-EWAX13:9-EWAX14:9-EWAX21:10-EWAX23:10-EWAX24:1
 -EWAX24:10
 -WA102X1AC2-WA102X2:AC15/28
 -EWBX41:2-EWBX42:2-EWBX51:15-EWBX52:15-EWBX1:7-EWBX2:7-EWBX3:7-EWB4:7
 -EWBX11:2-EWBX11:9-EWBX12:10-EWBX13:4-EWBX13:6-EWBX21:6-EWBX22:10-EWBX23:10
 -EWBX24:1-EWBX24:10
 -WB102X1AC2-WB102X2:AC15/28
 -EYAX1:15/16/17-EYAX2:1-EY100X1:11/12/13/14/15-EY100X13-EY100X41
 -C200X1:2-C200X2:17/18/19/20-X100X1:17/18/19/20-C100X10-C100X2:6/7/8/9/10-C300X4:6/7/8/9/10
 -C300X2:1/5
 -EZXR7 (cannot be used as signal ground at DuoDiagnost, only Optimus RAD-R/F)

GND_15V

ground (+15V) for desk hand switch

C300X3:1/2/6

HT_AN

high tension anode side actual value

EG100X14:2-EZX35:2-EZ130X1:C17

0 ... +10V = 0 ... +100 kV measured at 10kOhm (20kΩ measuring circuit parallel to 20kΩ kV_control)

HT_AN_GND

high tension anode side ground

EG100X14:10-EZX35:10-EZ130X1:A17

0V

HT_CA

high tension cathode side actual value

EG100X14:1-EZX35:1-EZ130X1:C16

0 ... -10V = 0 ... -100kV measured at 10kOhm (20kΩ measuring circuit parallel to 20kΩ kV_control)

HT_CA_GND

high tension cathode side ground

EG100X14:9-EZX35:9-EZ130X1:A16

0V

I1_1

partner of I1_1/ optocoupler signal IGBT1 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A1-EZX24:14-EQ100X1:14

measuring point: EQ100 R25 end to X1 * EQ100 X6

value: on = 3.7V off = 1.2V against ground * = X10

I1_1/

partner of I1_1 optocoupler signal IGBT1 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C1-EZX24:1-EQ100X1:1

I1_2

partner of I1_2/ optocoupler signal IGBT2 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A2-EZX24:15-EQ100X1:15

I1_2/

partner of I1_2 optocoupler signal IGBT2 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C2-EZX24:2-EQ100X1:2

measuring point: EQ100 R27 end to X1 * EQ100 X7

value: ON = 3.7V OFF = 1.2V against ground * = X10

I1_3

partner of I1_3/ optocoupler signal IGBT3 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A3-EZX24:16-EQ100X1:16

I1_3/

partner of I1_3 optocoupler signal IGBT3 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C3-EZX24:3-EQ100X1:3

measuring point: EQ100 R29 end to X1 * EQ100 X8

value: ON = 3.7V OFF = 1.2V against ground * = X10

I1_4

partner of I1_4/ optocoupler signal IGBT4 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A4-EZX24:17-EQ100X1:17

I1_4/

partner of I1_4 optocoupler signal IGBT4 power part 1

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C4-EZX24:4-EQ100X1:4

measuring point: EQ100 R31 end to X1 * EQ100 X9

value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_1

partner of I2_1/ optocoupler signal IGBT1 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A22-EZX34:14-E2Q100X1:14

I2_1/

partner of I2_1 optocoupler signal IGBT1 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C22-EZX34:1-E2Q100X1:1

measuring point: EQ100 R25 end to X1 * E2Q100 X6

value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_2

partner of I2_2/ optocoupler signal IGBT2 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A23-EZX34:15-E2Q100X1:15

I2_2/

partner of I2_2 optocoupler signal IGBT2 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C23-EZX34:2-E2Q100X1:2

measuring point: EQ100 R27 end to X1 * E2Q100 X7

value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_3

partner of I2_3/ optocoupler signal IGBT3 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A24-EZX34:16-E2Q100X1:16

I2_3/

partner of I2_3 optocoupler signal IGBT3 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C24-EZX34:3-E2Q100X1:3

measuring point: EQ100 R29 end to X1 * E2Q100 X8

value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_4

partner of I2_4/ optocoupler signal IGBT4 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:A25-EZX34:17-E2Q100X1:17

I2_4/

partner of I2_4 optocoupler signal IGBT4 power part 2

EQ100 = 4512 108 05882 release 2

EQ100 ≥ 4512 108 08621 * release 2

EQ100 ≥ 4512 108 09341 * release 3

EZ130X1:C25-EZX34:4-E2Q100X1:4

measuring point: EQ100 R31 end to X1 * E2Q100 X9

value: ON = 3.7V OFF = 1.2V against ground * = X10

IT_0V

emitter 0V exposure on signal

EWA100X2:C9-EWAX14:9

EWB100X2:C9-EWBX14:9

potential free optocoupler driven signal

in combination with EX_ON

part of: EXON old world

Iu

stator current phase U of low speed rotor control

measuring point EYAX22

10A/V

Iw

stator current phase W of low speed rotor control

measuring point EYAX21

10A/V

MN_EM_OF

mains power emergency off

EZX4:1-EZX47:6-EN100X1:6

MN_ON

mains on

C300X1:6-EZX46:6-EZX47:2-EN100X1:2-EZX44:14

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CB100X10:3-EZX46:6-EZX47:2-EN100X1:2-EZX44:14

Optimus C

NG_15V

-15V supply Vee

EZ102X2:DBZ24-EZ119X2:AC12-EZ130X2:AC12-EZ139X2:AC12-EZ150X2:AC12-EZX21:6-EZX22:6

-EZ31:6-EZX32:6-EZX41:6-EZX35:15-EZX51:8-EZX151:8-EG100X14:15

-14.5V ... -15.5V

NR_PR_X/

not ready preparing for X-ray

EZ139X1:A3-EZX23:3-EZX45:4-EZX46:4-C300X1:4-EWAX51:4-EWAX52:4-EWA100X2:A24-EWBX51:4
-EWBX52:4-EWB100X2:A24

driven by CU and/or system controller

measuring point: EZX83

part of: signal bus

0V/+15V high active

PO_0V

signal bus ground GNDS

EZ139X1:AC1-EZX23:1/14-EZX44:15-EZX45:15-EWAX51:15-EWAX52:15-EWBX51:15-EWBX52:15

part of: signal bus, supply via X44 Optimus RAD+R/F, from Cockpit at DuoDiagnost systems

PO_12V

+12 V supply

EN100X1:1-EZX47:1-EZX46:7-C300X1:7

PO_15V

+15V supply Vdd

EZ102X2:DBZ22-EZ119X2:AC11-EZ130X2:AC11-EZ139X2:AC11

-EZ150X2:AC11-EZX2:8/9-EZX35:7-EZX44:12/13-EZX46:5

-EZX51:7-EG100X14:7-C300X1:5

-EZX21/22/31/32/41:5

backpanel 4512 108 05983 only

-EZX151:7

backpanels 4512 108 05984 + 4512 108 09361/2 only

+14.5V ... +15.5V

PO_15/40V

+15V or +40V supply for measuring chamber

EZ150X1:A20-EZX21/22/31/32/41:5EZ150

version ≥ 4512 108 05964

EZX21/22/31/32/41:5 via (15/40V Sub-D/3+ adapter) EZX21/22/31/32/41:L EZ150

version 4512 108 05963

PO_26V

+26V supply

EZ102X2:DBZ28-EZ119X2:AC14-EZ130X2:AC14-EZ139X2:AC14-EZ150X2:AC14-EZX1:5-EZX2:3

-EZX3:9-EZX11:1-EWGX11:1-EWGX12:1-EZX17:1-EZX18:1-EQ100X2:1-E2Q100X2:1

PO_26V_1

+26V supply options

EZ102X2:DBZ32-EZX19:1-EZX20:1-

-EWAX1:4-EWAX2:4-EWAX3:4-EWAX4:4-EWAX41:1-EWAX42:1-EWAX23:9-EWAX24:5

-EWA100X2:AC14-EWBX1:4-EWBW2:4-EWBX3:4-EWBX4:4-EWBX41:1-EWAX42:1-EWBX21:9

-EWBX22:9-EWBX23:9-EWBX24:5-EWB100X2:AC14

-EZX8:1

backpanels 4512 108 05984 + 4512 108 09361/2

PO_26V_RE

+26V reverse supply

EWAW11-EWAW12-EWAX1/2/3/4:4-EWAX42:1

if generator and system release voltages do not match

normal condition: PO_26V_RE = +26V of generator against ground

(jumper WA W11 + W13 closed, W12 open)

special condition: PO_26V_RE = 0V against -24V, supply from stand

(jumper WA W11 + W13 open, W12 closed)

PO_26V_SW

+26V supply switched, for cooling fan low voltage power supply

EZ102X1:D32-EZX7:1-EM1

backpanels 4512 108 05984 + 4512 108 09361/2

PO_40V

+15V or + 40V supply for measuring chamber

EZ150X1:A20-EZX21/22/31/32/41:5 EZ150

version ≥ 4512 108 05964

EZX21/22/31/32/41:5 via (15/40V Sub-D/3+ adapter) EZX21/22/31/32/41:L EZ150

version 4512 108 05963

PO_400V

+400V supply measuring chamber

EZ150X1:AC1-EZX21/22/31/32/41:1

+400V, Ri of EZ150 = 100kOhms

PO_5V

+5V supply Vcc

EZ102X2:DBZ2/4/6-EZ119X2:AC1/2-EZ130X2:AC1/2-EZ139X2:AC1/2-EZ150X2:AC1/2-EZX46:9-C300X1:9
-EZX51:4/5/6-EZX151:4/5/6

+4.74V ... +5.25V

PO_V

signal bus supply

EZX23:13/25-EZX44:5-EZX45:7-EZ139X1:AC6

(V15S = -EWAX51:7-EWAX52:7-EWA100X2:AC27-EWBX51:7-EWBX52:7-EWB100X2:AC27)

+15V Vsgn, supply via X44 Optimus RAD+R/F, from Cockpit at DuoDiagnost systems part of signal bus

POWERFAIL/

power fail signal of low voltage power supply, initiates warm-boot if supply voltage phase L1 drops below 196VAC

EZ102X1:D30-EZ139X1:A10

PW_ON_NG

relay power on negative, energizes ENK1 if generator ready

EZ130X1:A15-EZX47:9-EN100X1:9

partner of PW_ON_PO

0V/+15V (pulled up by relay coil EN100 K2), low active

PW_ON_PO

supply relay power on positive,
EZ130X1:C15-EZX47:4-EN100X1:4
 partner of PW_ON_NG
 +15V

RC_ON/

rotor control on, low speed rotor control only

EZ150X1:A25-EZX51:1

backpanel 4512 108 05983

EZ150X1:A25-EZX51:1-EZX151:1

backpanels 4512 108 05984 + 4512 108 09361/2

measuring point EYAX28

RC_RD/

rotor control ready, low speed rotor control only

EYAX1:9-EXZ51:9-EZ150X1:C25

backpanel 4512 108 05983

EYAX1:9-EXZ51:9-EZX151:9-EZ150X1:C25

backpanels 4512 108 05984 + 4512 108 09361/2

measuring point EYAX25

RC_ST_2/

rotor control stator 2

EZ150X1:A26-EZX16:1-EWGX14:1

low speed rotor control

EY100X3:1-EWGX14:1

high speed rotor control

RC_ST_3/

rotor control stator 3

EZ150X1:C26-EZX16:2-EWGX14:2-EWGX15:1

low speed rotor control

EY100X3:2-EWGX14:2-EWGX15:1

high speed rotor control

RD_MN_ON

ready mains power on

C100X2:50-C300X4:50-C300X1:14-EZX46:14-EZX47:7-EN100X1:7

Optimus RAD – R/F

CB100X10:4- EZX46:14-EZX47:7-EN100X1:7

Optimus C

RD_PR_X**NR_PR_X/**

ReaDy preparing for X-ray or Not Ready preparing for X-ray

EZ139X1:A3-EZX23:3-EZX45:4-EZX46:4-C300X1:4- -EWAX51:4-EWAX52:4-EWA100X2:A24

driven by CU or other system components

measuring point: EZX83

part of: signal bus

0V/+15V high active signal

REL_CH1

release (reset integrator) chamber 1

EZ150X1:C6-EZX21:4

0V/+15V, typically +13V, high active

REL_CH2

release (reset integrator) chamber 2
EZ150X1:A6-EZX22:4
0V/+15V, typically +13V, high active

REL_CH3

release (reset integrator) chamber 3
EZ150X1:C12-EZX31:4
0V/+15V, typically +13V, high active

REL_CH4

release (reset integrator) chamber 4
EZ150X1:A12-EZX32:4
0V/+15V, typically +13V, high active

REL_CH5

release (reset integrator) chamber 5
also used as EXON signal for DSI
EZ150X1:C18-EZX41:4
0V/+15V, typically +13V, high active

RESET_1

external reset
resets incorrect, exposure indication, 5min fluoro buzzer, errors
EWBX22:7-EWB100X1:C23
0V/+26V low active

RESET_C/

internal RESET command for function units
EZ119X2:A6- EZ130X2:A6-EZ139X2:A6-EZ150X2:A6-EZX52:3-EZX45:3-EZX46:3-C300X1:3
-EZX51:10-EZX73-EWAX51:3-EWAX52:3-EWA100X1:A6-EWBX51:3-EWBX52:3-EWB100X1:A6-
-EZ151:10 backpanels 4512 108 05984 + 4512 108 09361/2
0V/+5V
measuring point EZX73
driven by CU, active (low) if: EZ139 S1 activated, RESET_SW/ ON signal bus active,
threatening power supply drop in, watchdog alarm, switch ON or warm-start,
resets FU's
part of: XS/XRG bus

RESET_SW/

signal bus reset, generator reset with turn ON or push of turn ON button as warm-start
EZX23:2-EZX44:6-EZ139X1:A2
0V/+15V low active
time constant $\geq 200\text{ms}$
resets CU only
measuring point: EZX81
part of: signal bus

RF_0V_CH1

0V reference value measuring chamber 1

EZ121:8-EZ150X1:C8

differential signal with SIGN_CH1

RF_0V_CH2

0V reference value measuring chamber 2

EZ122:8-EZ150X1:A8

differential signal with SIGN_CH2

RF_0V_CH3

0V reference value measuring chamber 3

EZ131:8-EZ150X1:C14

differential signal with SIGN_CH3

RF_0V_CH4

0V reference value measuring chamber 4

EZ132:8-EZ150X1:A14

differential signal with SIGN_CH4

RF_0V_CH5

0V reference value measuring chamber 5

EZ141:8-EZ150X1:C20

differential signal with SIGN_CH5

RG_DV_1

registration device 1 selected

EWA100X1:C4-EWAX1:5

EWB100X1:C4-EWBX1:5

RG_DV_2

registration device 2 selected

EWA100X1:A7-EWAX2:5

EWB100X1:A7-EWBX2:5

RG_DV_3

registration device 3 selected

EWA100X1:A9-EWAX3:5

EWB100X1:A9-EWBX3:5

RG_DV_4

registration device 4 selected

EWA100X1:A11-EWAX4:5

EWB100X1:A11-EWBX4:5

RG_DV_SL_1

registration device selection 1

cassette / camera switchover signal

EWBX21:1-EWB100X1:C18

0V/+26V low active

partner of RG_DV_SL_2, only one of these should be low active at a time

RG_DV_SL_2

registration device selection 2

camera / cassette switchover signal

EWBX21:2-EWB100X1:A19

0V/+26V low active

partner of RG_DV_SL_1, only one of these should be low active at a time

RM_DR_0V

room door contact 0V

EZ150X1:C28-EZX1:10-EWGX1:10-EWGX2:10-EWGX3:10

release 2 generators only, not used release 3 RAD-R/F and Optimus C

partner of RM_DR_CT signal release 2 RAD generators only

0V/+26V low active, detects room door contact signal short circuit at release 2 RAD generators during turn ON

RM_DR_CT

room door contact

EZ150X1:A28-EZX1:8-EWGX1:8-EWGX2:8-EWGX3:8 backpanels 4512 108 05983/4

EZ150X1:A28-EZX45:8-EWBX51:8-EWBX52:8-EWBX22:8-EZX1:8-EWGX1:8-EWGX2:8-EWGX3:8
backpanels 4512 108 09361/2

partner of RM_DR_0V signal release 2 RAD generators only

0V/+26V low active = door closed

RQ_M1_X/

request mode 1 (fluoro)

Optimus C only, not used

EZX23:9-EZ139X1:C4

RQ_M2_X/

request mode 2 (exposure)

Optimus C only, not used

EZX23:22-EZ139X1:C5

RQ_M3_X/

request mode 3

Optimus C only, not used

EZX23:10-EZ139X1:C7

RQ_SN_X/

request synchronization of X-ray, exposure request signal

EZX23:16-EZX45:12-EZX46:12-C300X1:12-EZ139X1:C3-EWAX51:12-EWAX52:12-EWA100X2:A25
-EWBX51:12-EWBX52:12-EWB100X2:A25

measuring point: EZX84

0V/+15V

part of: signal bus

RQ_XG_EX

request X-ray generator for exposure

EWAX1:1- EWAX1:2- EWAX1:3- EWAX1:4-EWA100X1:A3

EWBX1:1- EWBX1:2- EWBX1:3- EWBX1:4-EWB100X1:A3

0V/+26V low active, high if waiting for sync contact

partner of XG_RD_EX for grid sync (20-21)

RQ_XG_FL

request X-ray generator for fluoroscopy

EWAX1:6-EWAX2:6-EWAX3:6-EWAX4:6-EWA100X1:A5 not possible with WA

EWBX1:6-EWBX2:6-EWBX3:6-EWBX4:6-EWB100X1:A5

0V/+26V low active

RQ_XG_PR_1

request X-ray generator for preparation

EWAX1:3-EWA100X1:A4

EWBX1:3-EWB100X1:A4

0V/+26V low active

RQ_XG_PR_2

request X-ray generator for preparation

EWAX2:3-EWA100X1:C6

EWBX2:3-EWB100X1:C6

0V/+26V low active

RQ_XG_PR_3

request X-ray generator for preparation

EWAX3:3-EWA100X1:C8

EWBX3:3-EWB100X1:C8

0V/+26V low active

RQ_XG_PR_4

request X-ray generator for preparation

EWAX4:3-EWA100X1:C10

EWBX4:3-EWB100X1:C10

0V/+26V low active

RX_CAN_1

system CAN 1 optional

EZX44:3-EZ139X1:C15

RX_CAN_2
system CAN 2 optional
EZ43:1-EZ44:11

S_CAN_GND
system CAN bus ground
EZ139X1:C17-EZ42:3/6-EZ43:3/6-EZ44:9
-(EZ44:9- EZ44:1- to GND via function programming plug 4512 130 54441 Optimus RAD only)
part of: system CAN

S_CAN_L
system CAN low active
EZ139X1:C16-EZ42:2-EZ43:2
+2.5VDC standby, +1.5VDC during communication
part of: system CAN

S_CAN_H
system CAN high active
EZ139X1:A16-EZ42:7-EZ43:7
+2.5VDC standby, +3.2VDC during communication
part of: system CAN

S_CAN_PO
system CAN supply
EZ44:4-EZ42:9-EZ43:9-EZ139X1:A17
-(EZ44:12-EZ44:9 supply via function programming plug 4512 130 54441 Optimus RAD only)
typically +12V, Vcan
part of: system CAN

SI_PH/
single phase identifier
EN100X1:5-EZ47:5-EZ130X1:C14

SI_PH_ID
single phase identifier
EN100X1:5-EZ47:5-EZ130X1:C14

SIGN_CH1
dose signal of measuring chamber 1
EZ21:7-EZ150X1:C7
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH1

SIGN_CH2
dose signal of measuring chamber 2
EZ22:7-EZ150X1:A7
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH2

SIGN_CH3

dose signal of measuring chamber 3
EZ31:7-EZ150X1:C13
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH3

SIGN_CH4

dose signal of measuring chamber 4
EZ32:7-EZ150X1:A13
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH4

SIGN_CH5

dose signal of measuring chamber 5
EZ41:7-EZ150X1:C19
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH5

SL_CO_1

select correction 1
external patients size correction, slim patient
EWA100X1:A32-EWAX24:8
EWB100X1:A32-EWBX24:8
0V/+26V low active for selection or when selected from generator desk

SL_CO_2

select correction 2
external patients size correction, stout patient
EWA100X1:C32-EWAX24:9
EWB100X1:C32-EWBX24:9
0V/+26V low active for selection or when selected from generator desk

SL_PG_1

select external APRT program 1
EWA100X1:A28-EWAX23:1
EWB100X1:A28-EWBX23:1
0V/+26V low active for selection or when selected from generator desk

SL_PG_2

select external APRT program 2
EWA100X1:C28-EWAX23:2
EWB100X1:C28-EWBX23:2
0V/+26V low active for selection or when selected from generator desk

SL_PG_3

select external APRT program 3
EWA100X1:A29-EWAX23:3
EWB100X1:A29-EWBX23:3
0V/+26V low active for selection or when selected from generator desk

SL_PG_4

select external APRT program 4

EWA100X1:C29-EWAX23:4

EWB100X1:C29-EWBX23:4

0V/+26V low active for selection or when selected from generator desk

SL_PG_5

select external APRT program 5

EWA100X1:A30-EWAX23:5

EWB100X1:A30-EWBX23:5

0V/+26V low active for selection or when selected from generator desk

SL_PG_6

select external APRT program 6

EWA100X1:C30-EWAX23:6

EWB100X1:C30-EWBX23:6

0V/+26V low active for selection or when selected from generator desk

SL_PG_7

select external APRT program 7

EWA100X1:A31-EWAX23:7

EWB100X1:A31-EWBX23:7

0V/+26V low active for selection or when selected from generator desk

SL_PG_8

select external APRT program 8

EWA100X1:C31-EWAX23:8

EWB100X1:C31-EWBX23:8

0V/+26V low active for selection or when selected from generator desk

SL_TO_TM_1

select tomo time 1

tomo time input from stand

EWAX21:1-EWA100X1:A24

0V/+26V low active

SL_TO_TM_2

select tomo time 2

tomo time input from stand

EWAX21:2-EWA100X1:C24

0V/+26V low active

SL_TO_TM_3

select tomo time 3

tomo time input from stand

EWAX21:3-EWA100X1:A25

0V/+26V low active

SL_TO_TM_4

select tomo time 4

tomo time input from stand

EWAX21:4-EWA100X1:C25

0V/+26V low active

SL_TO_TM_5

select tomo time 5

tomo time input from stand

EWAX21:5-EWA100X1:A26

0V/+26V low active

SL_TO_TM_6

select tomo time 6

tomo time input from stand

EWAX21:6-EWA100X1:C26

0V/+26V low active

SL_TO_TM_7

select tomo time 7

tomo time input from stand

EWAX21:7-EWA100X1:A27

0V/+26V low active

SL_TO_TM_8

select tomo time 8

tomo time input from stand

EWAX21:8-EWA100X1:C27

0V/+26V low active

SL_XG_TO

select X-ray generator for tomography

EWAX11:3-EWAX12:3-EWA100X1:C18

0V/+26V, low active

STOP_X_C/

stop X-ray command, X-ray OFF from function units mA and dose rate control (on-board of CU)

EZ119X2:A7-EZ130X2:A7- EZ139X2:A7-EZ150X2:A7-EZX52:40V/5V

measuring point EZX75

inactivates CTRL_X_C/

EXOF exposure OFF command

part of: XS/XRG bus

STU

stator phase U

EYAX2:2-EX1101 low speed rotor control single tube

EYAX2:2-EWGK11:1-EWGK12:1=EWGK11:2=EWGK12:2

EY100X46:2-EX1101

low speed two tubes

high speed rotor control

vers. 4512 104 33791/2 or 71401..6 single tube

EY100X46:2-EWGK11:1-EWGK12:1=EWGK11:2=EWGK12:2

high speed rotor control

vers. 4512 104 33791/2 or 71401..6 two tubes

EY100X51-EX1101

high speed rotor control

vers. 4512 104 71421/61 single tube

EY100X51--EWGK11:1-EWGK12:1=EWGK11:2=EWGK12:2

high speed rotor control

vers. 4512 104 71421/61 two tubes

STV

stator phase V = common

EYAX2:3-EX1102

low speed rotor control single tube

EYAX2:3-EWGK11:3-EWGK12:3=EWGK11:4=EWGK12:4

low speed two tubes

EY100X47:1-EX1102

high speed rotor control

vers. 4512 104 33791/2 or 71401..6 single tube

EY100X47:1-EWGK11:3-EWGK12:3=EWGK11:4=EWGK12:4

high speed rotor control

vers. 4512 104 33791/2 or 71401..6 two tubes

EY100X52-EX1102

high speed rotor control

vers. 4512 104 71421/61 single tube

EY100X52--EWGK11:3-EWGK12:3=EWGK11:4=EWGK12:4

high speed rotor control

vers. 4512 104 71421/61 two tubes

STW

stator phase W

EYAX2:4-EX1103

low speed rotor control single tube

EYAX2:4-EWGK11:5-EWGK12:5=EWGK11:6=EWGK12:6

low speed two tubes

EY100X47:2-EX1103

high speed rotor control

vers: 4512 104 33791/2 or 71401..6 single tube

EY100X47:2-EWGK11:5-EWGK12:5=EWGK11:6=EWGK12:6

high speed rotor control

vers. 4512 104 33791/2 or 71401..6 two tubes

EY100X53-EX1103

high speed rotor control

vers. 4512 104 71421/61 single tube

EY100X53--EWGK11:5-EWGK12:5=EWGK11:6=EWGK12:6

high speed rotor control

vers. 4512 104 71421/61 two tubes

SW_BU_1

switch bucky 1 ready (WA + WB)

EWAX11:10-EWA100X1:C19

EWBX11:10-EWB100X1:C19

part of: bucky ready contact

0V/+26V low active

SW_BU_2

switch bucky 2 ready (WA only)

EWAX12:10-EWA100X1:A21

part of: bucky ready contact

0V/+26V low active

SW_OF_FD_1

switch OFF field 1

format size correction < 14cm or if cone in use serial changer chamber

EWBX13:5-EWB100X1:C21

0V/+26V low active

SW_ON_FD_3

switch ON field 3

format size correction > 24x24cm serial changer chamber

EWBX13:7-EWB100X1:A22

0V/+26V low active

SW_PR_FL_1

switch preparation or fluoro 1

contact to drive an external prep or fluoro indication lamp

EWBX22:2-EWB100X1:C13

partner of COM_EX_CD

SW_SF_CF_1

switch side field to central field bucky measuring chamber (WA + WB)

EWAX11:1-EWA100X1:A18

EWBX11:1-EWB100X1:A18

cassettes < 23cm

0V/+26V low active

SW_SF_CF_2

switch side field to central field bucky measuring chamber 2 (WA only)

EWAX12:1-EWA100X1:A20

cassettes < 23cm

0V/+26V low active

SW_TO_1

switch tomography 1 ready

EWAX11:5-EWA100X1:A19

part of: tomo ready contact

0V/+26V low active

SW_TO_2

switch tomography 2 ready

EWAX12:5-EWA100X1:C20

part of: tomo ready contact

0V/+26V low active

SW_UN_EX

radiation indication

EZ150X1:A29-EZX1:4-EWGX1:4

partner of CM_SW, potential free contact

SW_UN_EX_1
 radiation indication
 (EWGX1:4)=EWGX2:4
 partner of CM_SW, potential free contact

SW_UN_EX_1
 switch radiation indication 1
 contact to drive an external X-ray indication lamp
 EWBX22:4-EWB100X1:C14
 partner of COM_EX_CD

SW_UN_EX_2
 radiation indication
 (EWGX1:4)=EWGX3:4
 partner of CM_SW, potential free contact

SW_XG_RD_1
 switch generator ready 1
 contact to drive an external ready indication lamp
 EWBX22:1-EWB100X1:A13
 partner of COM_EX_CD

SW_WN_FL_1
 switch warning fluoro 1
 contact to drive an external fluoro warning indication lamp (> 5 minutes)
 EWBX22:3-EWB100X1:A14
 partner of COM_EX_CD

TB_2/
 tube 2 selected
 EZ130X1:A13-EZX11:2-EWGX11:2
 0V/15V, low active

TB_2_RT
 tube 2 return signal, tube selection check
 EWGX11:3-EZX11:3-EZ130X1:A10
 0V/5V, low active

TB_3/
 tube 3 selected
 EZ130X1:C13-EZX11:5-EWGX11:5-EWGX12:2
 0V/15V, low active

TB_3_RT
 tube 3 return signal, tube selection check
 E2WGX11:3-E1WGX12:3-E1WGX11:6-EZX11:6-EZ130X1:C10
 0V/5V, low active

TB_CU_FR_NG

tube current frequency negative

EG100X14:14-EZX35:14-EZ119X1:BZ32

-14V against ground, frequency: 1 kHz = 2mA, 0 ... 1500mA 500kHz/A

differential signal with TB_CU_FR_PO

TB_CU_FR_PO

tube current frequency positive

EG100X16:6-EZX35:6-EZ119X1:BZ30

-14V against ground, frequency: 1 kHz = 2mA, 0 ... 1500mA 500kHz/A

differential signal with TB_CU_FR_NG

TH_OL

tube housing overload

NTC temperature measurement in tube housing (not yet available)

EZ130X1:A12-EZX3:6-EWGX7:6-EWGX8:6-EWGX9:6

backpanel 4512 108 05983

EZ130X1:A12-EZX3:3-EWGX7:3-EWGX8:3-EWGX9:3

backpanels 4512 108 05984 + 4512 108 09361/2

4.4V ... 1.5V = 20 ... 100 degrees C

partner of CM_TH

TH_OL_SW/

tube housing overload switch

EZ130X1:A11-EZX3:3-EWGX7:3-EWGX8:3-EWGX9:3

backpanel 4512 108 05983

EZ130X1:A11-EZX3:6-EWGX7:6-EWGX8:6-EWGX9:6

backpanels 4512 108 05984 + 4512 108 09361/2

0V ... 1.7V = short circuit, 1.7V ... 3.3V = closed, >3.3V open

partner of CM_TH_SW

TOMO_PG

tomo mode programmed

EWA100X1:A17-EWAX22:9

common line for tomo trajectory selection TO_PG_1 ... 8 to stand, potential free

TO_PG_1

tomo program 1

EWA100X1:A13-EWAX22:1

tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_2

tomo program 2

EWA100X1:C13-EWAX22:2

tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_3

tomo program 3

EWA100X1:A14-EWAX22:3

tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_4
 tomo program 4
 EWA100X1:C14-EWAX22:4
 tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_5
 tomo program 5
 EWA100X1:A15-EWAX22:5
 tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_6
 tomo program 6
 EWA100X1:C15-EWAX22:6
 tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_7
 tomo program 7
 EWA100X1:A16-EWAX22:7
 tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_8
 tomo program 8
 EWA100X1:C16-EWAX22:8
 tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_SL
 tomo program selected
 EWA100X1:C17-EWAX22:10
 tomo APR selected = closed, overriding = open, potential free contact with TOMO_PG

TP_HT_GND
 temperature high tension tank ground
 EZ130X1:A19-EZX35:12-EG100X14:4
 partner of TP_HT_SG

TP_HT_SG
 temperature signal high tension tank
 NTC in high tension tank oil
 EG100X14:12-EZX35:4-EZ130X1:C19
 4.4V ... 1.5V = 20 ... 100°C
 +25 _C(12kW) ... +100 _C(950W)
 partner of TP_HT_GND

V15C
 (S_CAN_PO) backpanel 4512 108 05983 only
 system CAN supply
 EZX42:9-EZX43:9-EZX44:4-EZ139X1:A17
 Vcan
 part of: system CAN

V15S

signal bus supply

backpanel 4512 108 05983 only

EZX23:13/25-EZX44:5-EZX45:7-EZ130X1:AC6-EWAX51:7-EWAX52:7-EWA100X2:AC27

+15V Vsgn

part of: signal bus

VO_CR_IF_0

density voltage correction II format dependent 10"

EWBX13:3-EWB100X1:C22

0V/+26V low active

VO_CR_IF_1

density voltage correction II format dependent 5" / 6"

EWBX13:9-EWB100X1:A23

X_ACT/

X-ray active signal bus

EZ139X1:A5-EZX23:5-EZX45:6-EWAX51:6-EWAX52:6-EWA100X2:C24-EWBX51:6-EWBX52:6
-EWB100X2:C24

driven by CU if X_ACT_S/ was sent from FU-kV or during fluoro, old: EXON signal

measuring point: EZX86

part of: signal bus

0V/+15V

X_ACT_S/

X-ray active signal

kV > 75% nominal value driven by FU-kV or fluoroscopy high tension on driven by CU

EZ119X2:A8-EZ130X2:A8-EZ139X2:A8-EZ150X2:A8-EZX52:5-EZX77

0V/+5V

measuring point EZX77

part of: XS/XRG bus, controls X_ACT/ status

XG_RD_EX_1

X-ray generator ready for exposure request

grid / sync release signal

EWA100X1:C3-EWAX1:2

EWAB100X1:C3-EWBX1:2

0V/+26V low active

partner of RQ_XG_EX for grid sync (20-21)

XG_RD_EX_2

X-ray generator ready for exposure request

grid / sync release signal

EWA100X1:A6-EWAX2:2

EWB100X1:A6-EWBX2:2

0V/+26V low active

partner of RQ_XG_EX for grid sync (20-21)

XG_RD_EX_3

X-ray generator ready for exposure request

grid / sync release signal

EWA100X1:A8-EWAX3:2

EWB100X1:A8-EWBX3:2

0V/+26V low active

partner of RQ_XG_EX for grid sync (20-21)

XG_RD_EX_4

X-ray generator ready for exposure request

grid / sync release signal

EWA100X1:A10-EWAX4:2

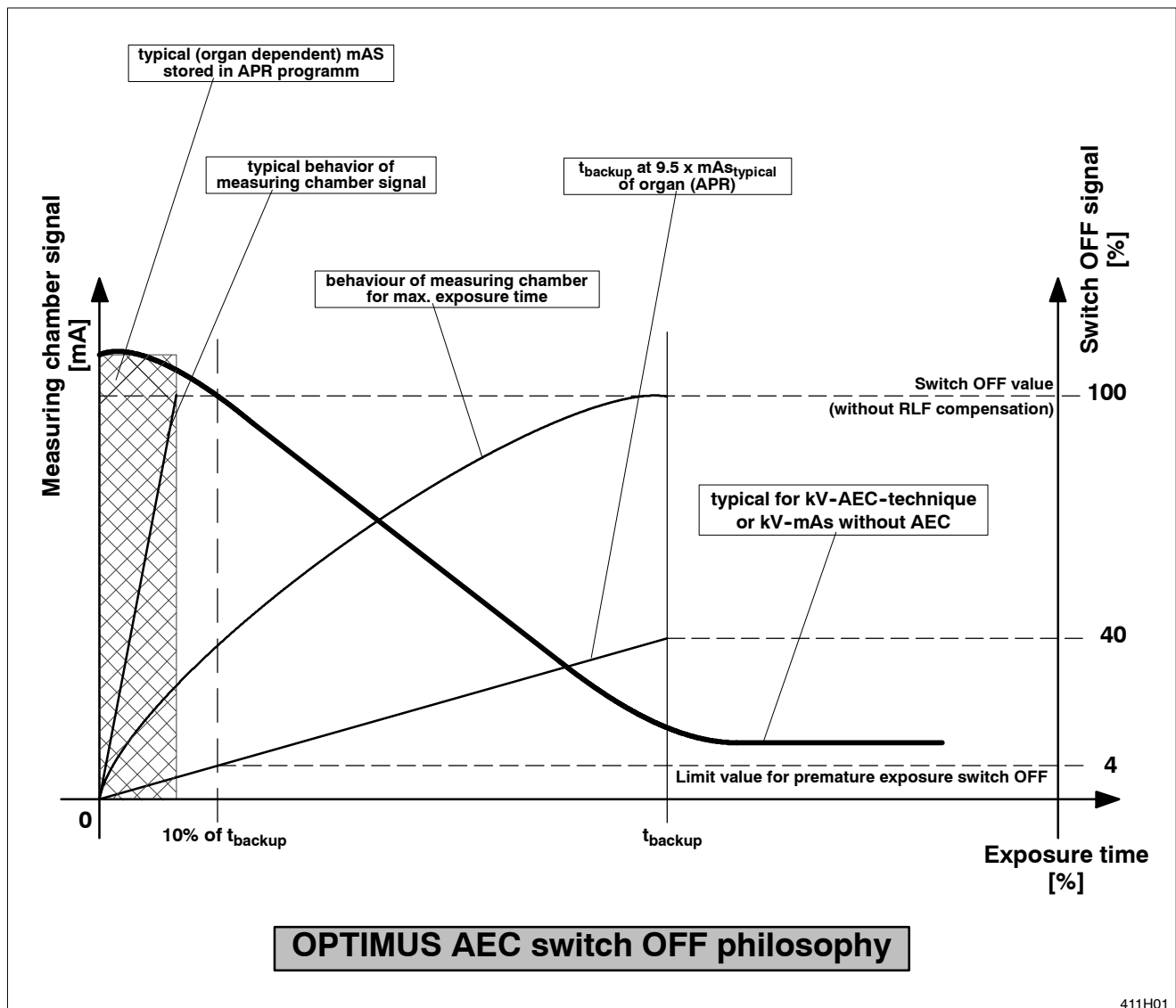
EWB100X1:A10-EWBX4:2

0V/+26V low active

partner of RQ_XG_EX for grid sync (20-21)

13. OPTIMUS AEC switch OFF philosophy

For explanation the following figure:



Every APR using the AEC technique as the preferred technique must have mAs, mA-s or mAs-s parameters in the background. These should almost match the typical organ-related dose to the selected film/screen combination.

A film which got at least 40% of the desired density can be used for diagnosis.

If the AEC exposure starts now two supervisions are active with the aim of not giving unnecessary dose (or simply a proper AEC exposure is obtained):

1. The organ-dependent background mAs value is multiplied with 9.5. If the exposure is not finished at $9.5 \times \text{mAs}_{\text{backup}}$ the generator stops. One must expect that something went wrong if the exposure exceeded 9.5 times the typical mAs value. This exposure has not been cut OFF by the supervision 2.
2. With the $9.5 \times \text{mAs}_{\text{backup}}$ a kV and filament load dependent backup time is calculated by DRC (dose rate control). At 10% of this time value DRC checks if at least 4% of the desired dose has been detected by the measuring chamber.
If the 4% limit does not increase, the exposure switches OFF. The minimum of 40% density cannot be obtained during the remaining backup time.

This 4% dose detection is automatically OFF, if the film/screen combination is too sensitive (> 400 speed systems). The 4% value is too small to be reliable for a measurement.

With overriding the supervision switches OFF.

How to test the limits of 600mAs or 4000ms in AEC technique

One has to bypass the 4% detection and the background mAs value must be high enough to reach 600mAs. The 4% detection can be switched OFF with modifying the value dose of FSC [μGy]:

- Type in a value of 1 (which is equal to a 1000 speed system) in the dose of FSC data field of any of the programmed film/screen combinations.
- Now select any APR and increase the background mAs value to 100mAs.
- Close the collimator or cover the chamber with lead.

The AEC exposure stops at a value which is always below 600mAs, a typical limit is 588mAs.

With the modified parameters the 4000ms test can be carried out:

- Select the modified APR on the control desk and go to <SELECT APR> and <CHANGE APR> with the PC.
- Reduce the le max factor to 5% and transmit the APR screen.
- Select the APR button again, the modified data are active now.
- Select the small focal spot.
- Switch an AEC exposure. It should last 4000ms.
- Change all modifications back to normal.

The supervision can be switched ON or OFF, programming path:

XRGSCOPE - Optimus (XRG90) - Programming - Dose Rate Control - AMPLIMAT - Fault Exposure Detection - AEC or TDC - ON/OFF

(Explanation see documentation.)

Precalculation tables of the exposure which is actually displayed on the control desk can be seen on the PC under:

XRGSCOPE - Optimus (XRG90) - Faultfind - X-Ray Log - Dose Rate Control Logging - etc.

14. AEC fault exposure detection strategy

The major intention of having a fault exposure detection is to prevent unnecessary radiation for the patient in case of a malfunction of the installation or a mistake when handling the X-ray equipment.

AEC fault exposure detection = ON

The factors determining whether the 4% dose value at 10% of the APR backup time are checked are

- the 10% backup time value > 10ms
- the expected 4% density voltage value > 20mV

In case of APR100 the check could be performed because the density voltage values are high enough.

The density voltage at 10% of the backup time would be too small to be measured for APR800, therefore the exposure continues up to the 9.5 x APR mAs value. The exposure finally terminates at 570mAs if the APR mAs value is ≥ 60 mAs.

With APR100* the exposure terminates at 10% of the max backup time, which is 4000ms for all AEC exposures after overriding of any APR parameters. (The 600mAs limit does not switch OFF the exposure, 1500mA emission current is not available).

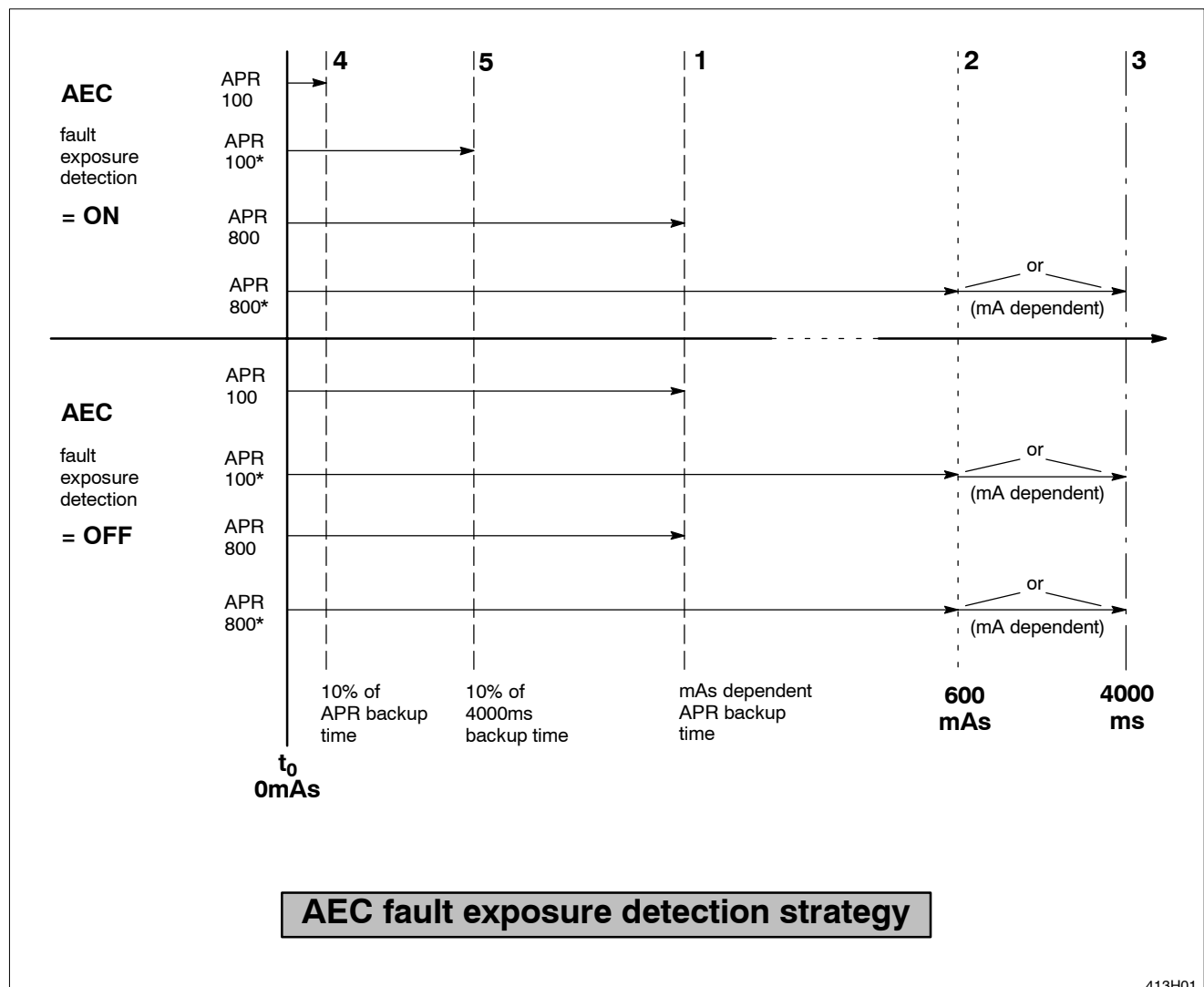
With APR800* the exposure terminates either at 600mAs or 4000ms, depending on which of the limits is reached first.

AEC fault exposure detection = OFF

APR100 and APR800 exposures have the same termination point at 9.5 x APR mAs. The exposure finally terminates at 570mAs, if the APR mAs value is ≥ 60 mAs.

APR100* and APR800* exposures terminate either at 600mAs or at 4000ms, depending on which of the limits is reached first.

For explanations see figure and list of terms on following 2 pages.



List of terms

AEC	=	Automatic Exposure Control
APR100	=	APR program with a less sensible film/screen combination of 100 speed, original parameters as programmed.
APR100*	=	as same as APR100, but parameter(s) modified on the control desk (overriding).
APR800	=	APR program with a very sensible film/screen combination of 800 speed, original parameters as programmed.
APR800*	=	as same as APR800, but parameter(s) modified on the control desk (overriding).
600mAs	=	programmed mAs limit for AEC exposures (can be changed, must comply with the local regulations).
4000ms	=	max time limit of AEC exposures (cannot be changed).
	1	= point of the mAs dependent APR backup time, which is calculated from the 9.5 x (typical) organ mAs value of the APR
	2	= max mAs limit for AEC exposures (can be changed)
	3	= max exposure time limit of 4000ms (cannot be changed)
	4	= 10% (of the APR backup) time point
	5	= 10% backup time point of the max exposure time limit (4000ms) = always 400ms

To explain the difference in switching the fault exposure detection **ON** or **OFF**, a very sensible (800 speed system) and a less sensible (100 speed system) film/screen combination have been chosen.

15. Explanations on programming the generator

- Select menu:
OPTIMUS\ PROGRAM\ DOSE RATE CONTROL\ **CONT ...**

scantime_TV [ms]: [20.000] = default 20ms
20ms must be programmed for all TV chains with a scantime \leq 20ms.

- In case a TV chain has a longer scantime program the actual scantime value:

scantime_TV [ms] = [20.000] for scantime of TV chain \leq 20ms
or
scantime_TV [ms] = [xx.xxx] for scantime of TV chain = xx.xxx ms $>$ 20ms

scantime_TV valid: YES (default)

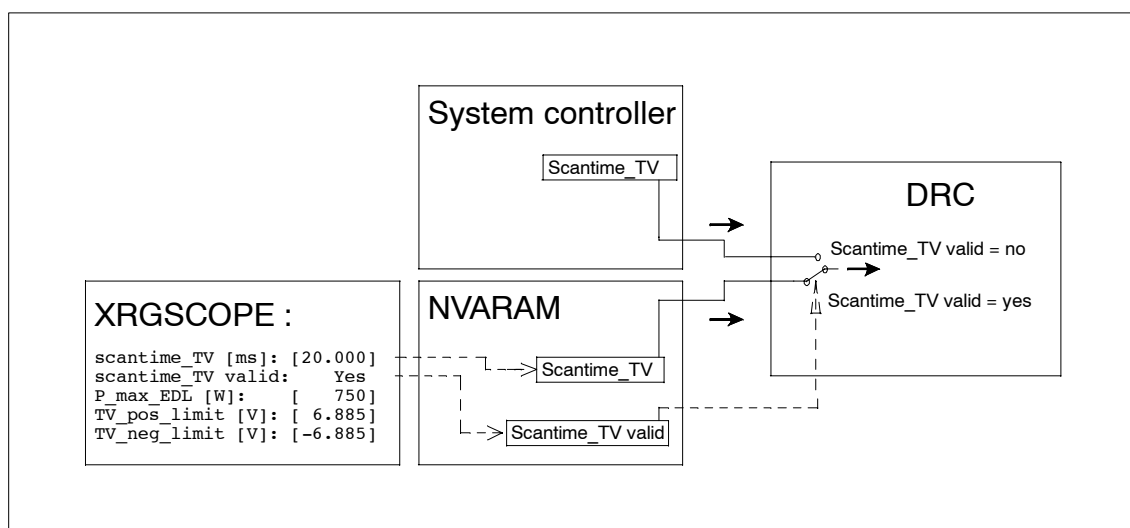
With **YES**, the programmed variable scantime_TV [ms] is used for the control in FU Dose Rate Control (DRC).

At the moment only this value is possible.

With **NO**, the programmed variable scantime_TV [ms] is **not** used for the control in FU Dose Rate Control (DRC).
The variable is delivered by the system controller.

This version is a future option. At the moment it is not applicable.

See figure explaining the program settings below:



16. Printed-circuit boards

Low-voltage power supply: EZ102

Also see Z1-2.3 "Low-voltage power supply".

LEDs H2 to H5 indicate whether the supply voltages are present.

The low-voltage power supplies of PCB EZ102 are short circuit proof. Therefore it is most likely that in case one of the LEDs grows dark one of the external consumers and not the PCB itself is the cause of the error.

It is recommended that one after the other all consumers be disconnected from the respective power supply until the LED is illuminated again.

The last consumer that was removed has probably caused the short-circuit.

EWA102 RAD+R/F
EWB102 R/F
Universal I/O (option)

EZ102 Low voltage supply	EZ119 mA control	EZ130* kV control	EZ130* kV control	EZ139 Central unit	EZ150 Basic interface	
<div><div><div>H1</div><div>H2</div><div>H3</div><div>H4</div><div>H5</div></div><div><div>Line</div><div>+26V</div><div>+15V</div><div>+5V</div><div>-15V</div></div></div>	<div><div><div>[2.5AV]</div><div>average value</div><div><div>X7</div><div>X800</div></div><div><div>H800</div><div>X801</div><div>X4</div><div>X8</div></div></div><div><div>status</div><div>watching</div><div>clock</div></div></div>	<div><div><div>[20kV/V]</div><div><div>X3</div><div>X4</div><div>X5</div><div>X6</div><div>X23</div><div>X26</div><div>X32</div></div><div><div>AV HT</div><div>AV HT AN</div><div>AV HT CA</div><div></div><div>Gain in</div><div>Ucomp</div><div></div></div></div><div><div>H800</div><div>X800</div></div></div>	<div><div><div>[20kV/V]</div><div><div>X3</div><div>X4</div><div>X5</div><div>X6</div><div>X23</div><div>X26</div><div>X32</div></div><div><div>AV HT</div><div>AV HT AN</div><div>AV HT CA</div><div></div><div>Gain in</div><div>Ucomp</div><div></div></div></div><div><div>H800</div><div>X800</div></div></div>	<div><div><div>S1</div><div>●</div><div>reset</div></div><div><div>H1</div><div>⊗</div><div>status</div></div><div><div>X5</div><div>25 pole</div></div></div>	<div><div><div>X3</div><div>X4</div><div>X6</div><div>X5</div></div><div><div>DS MC 0V</div><div>DS MC SG</div><div>EN X C/</div><div></div></div><div><div>H1</div><div>⊗</div><div>status</div></div></div>	<div><div><div>S1</div><div>FLUORO</div><div>ON</div><div>OFF</div><div>S2</div><div>PREP</div><div>ON</div><div>OFF</div></div><div><div>H1</div><div>⊗</div><div>status</div></div></div>

* EZ130 dependent on SW Rel.-level

Central rack,
service aid

REPLACEMENT TEXT

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1. Traceable items

Trace items are:

1. Generator cabinet
2. H.V. tank

They are labelled as follows:

- | | | |
|--|---|----------------|
| <ul style="list-style-type: none"> - type number - serial number (s/n) - manufacturer - HHS certification - code number | } | combined label |
|--|---|----------------|

With new traceable items for replacement a separate label is delivered.
This must be affixed to the label bracket on the top left corner of the generator cabinet.
See drawing 2Z-10 "Labelling".

The new type number, code number and serial number must be entered on the master card for the generator.

Please, send a copy of the corrected master card as FAX to:

Philips Medical Systems
DMC Hamburg, Germany
Department: GEN-OPERATION
FAX No.: +49 40 5078 1247

1.1. Generator cabinet

The generator cabinet as a traceable item is labelled by a 6-digit serial number:

Example:

s/n 02 1234

Meaning:

02	=	year of manufacture, e.g. 2002
1234	=	consecutive number

1.2. H.V. tank

H.V. tanks have a 7-digit serial number which has the following meaning:

Example:

s/n 02 01 123

Meaning:

02	=	year of manufacture, e.g. 20 02
01	=	power class, e.g. 50kW, 1 tube
123	=	consecutive number

Power classes:

01	=	50kW, 1 tube
03	=	65/80kW, 1 tube

Caution!

An exchange of a H.V. tank requires a new alignment of "Function Unit kV".
For alignment work refer to chapter 4 in this section.

2. Printed-circuit boards

PCB	HW programming	SW programming via XRGSCOPE	Tube adaptation	Remarks
EZ backpanel	<ul style="list-style-type: none"> see Z2-5.1/.2/.3 			To attend to: X4 emergency OFF X10 EN_X/ X42 system CAN termination X44 function programming plug X45 generator CAN termination X52 shall not be present
EZ102 low voltage supply				
EZ119 mA control	<ul style="list-style-type: none"> exchange PROM or insert new PROM set battery jumper to ON see 5Z-1 	<ul style="list-style-type: none"> load tube data set(s) 	all tubes	Bucky TH, Digital Diagnost, Thoravision systems: <ul style="list-style-type: none"> Set RGDV according to adaptation. See section 2, chapter 8.3.2.
EZ130 kV control	<ul style="list-style-type: none"> exchange PROM or insert new PROM see 5Z-1 			<ul style="list-style-type: none"> Carry out alignment of "Function Unit kV".
EZ139 CU	<ul style="list-style-type: none"> exchange BOOT PROM or insert new PROM see 5Z-1 	<ul style="list-style-type: none"> set date and time restore CU complete or start programming from beginning 		<ul style="list-style-type: none"> Carry out alignment of "Function Unit kV" if no CU complete files are present.
EZ150 basic interface	<ul style="list-style-type: none"> see 5Z-1 	<ul style="list-style-type: none"> check AMPLIMAT sensitivity according to jumper W4 		<ul style="list-style-type: none"> Set jumpers W2 + W3 according to required chamber supply. Set jumper W4 according to programmed AMPLIMAT sensitivity.

PCB	HW programming	SW programming via XRGSCOPE	Tube adaptation	Remarks
EN100 power ON circuit				
EG100 measuring circuit				Exchange is not allowed. Requires alignment which is not possible in the field. • Exchange the whole tank.
EY100 rotor control high speed	<ul style="list-style-type: none"> • swap PROM or insert new PROM • see 5Z-2 			

3. Exchange of firmware or update to Rel. 1.2

NC: 9890 000 0259x Firmware OPTIMUS C Rel. 1.2
4512 114 2691x Central Unit

It must be loaded from the PC into the respective flash PROMs.

For loading firmware release 1.2 the following firmware levels must be present in the generator:

- CU-Boot : ≥ 4512 113 2700x
- FU-kV : ≥ 4512 113 2621x OPTIMUS R/F + C
- FU-mA : ≥ 4512 113 2021x
- FU-CIE : ≥ 4512 113 2031x
- FU-RoCo : ≥ 4512 113 2232x units 4512 104 7142x
 ≥ 4512 113 2231x units 4512 104 7140x

Caution!

Before changing the release, save all configuration data of the generator!
Refer to chapter 3.2.1 "Backup of all configuration data".

3.1. Preparation of the service PC to guarantee a safe loading process

Start XRGSCOPE always from DOS if possible.

In case of any WINDOWS version:

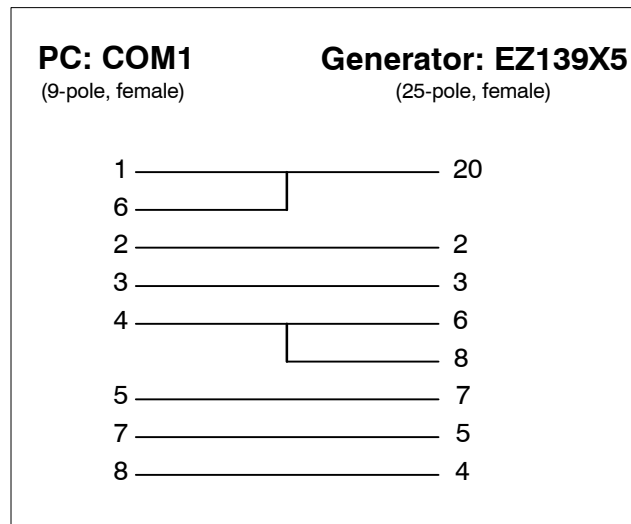
- Switch OFF all screensavers.
- Do not run other programs.
- Do not insert any CD in the drive.

Any kind of power management of the PC hardware (BIOS) as well as the windows power management should be switched OFF.

If the PC is connected to mains power some of these might be automatically OFF.

3.2. Backup / Installation procedure

- Provide the service PC with the hardware key and switch it ON.
The hardware key provides access to special program settings and to menu **"Faultfind"**.
Standard programming is possible without a hardware key.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable:
(A 5m long data cable can be ordered via 12NC: 4512 130 56931)



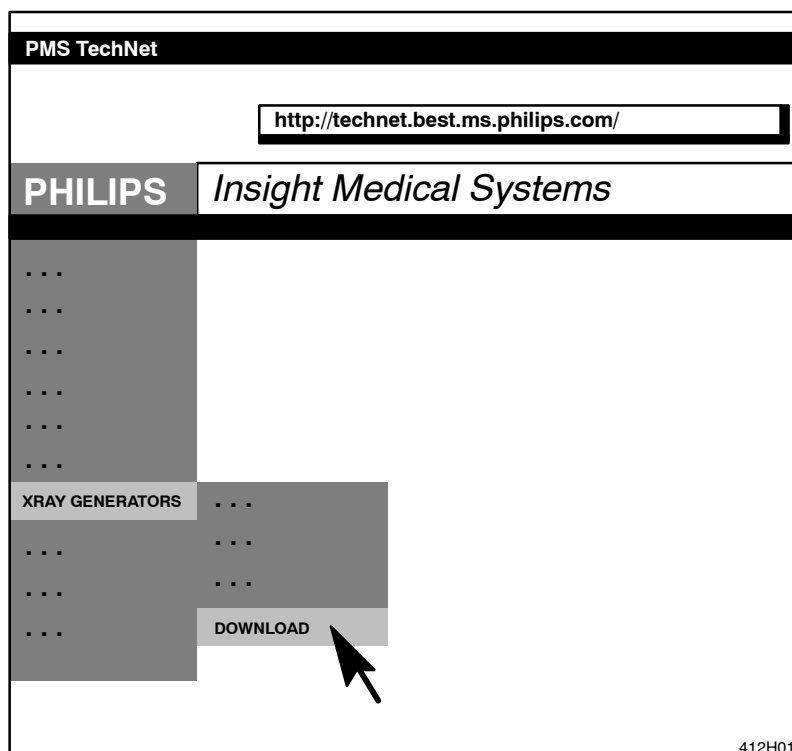
- Insert the floppy disk containing the self-unpacking exe-files of the firmware in the disk drive of the PC:
- OMC : 4512 116 024xx
For unpacking on the harddisk of the PC about 5MB are needed.
- Generate a directory e.g. [C:\OPT_C] on the PC by typing **<md C:\OPT_C>** or use WIN commands.
- Copy the firmware from floppy disk to the PC into the same directory [C:\OPT_C] by typing **<copy A:*. * C:\OPT_C>** or use WIN commands.
- Start unpacking the programs by typing **<OMCxxxxx.exe>** or doubleclick on **<*.exe>** -file.
The program unpack all files needed for the update of the firmware and the newest service tools.
- After unpacking [OMCxxxxx.exe] can be deleted on the harddisk by typing **<del OMCxxxxx.exe>**.
- For the current contents of [OMCxxxxx.exe] read [OMCxxxxx.txt] on the floppy disk.
- For further installation of the firmware in the generator read [README.txt].

General information:

- Button <F1> <help> Call help / cancel help.
- Button <F2> <transmit> Store screen contents / data set in the generator ==> transmit to generator.
- Button <F3> <save> Store data screen on disk.
For an open data screen the path desired can be selected.
- Button <F4> <load> Load data set from disk. The desired path can be selected.
- Button <ESC> Commands one step back. Can be used repeatedly.
- Fields with ↓ Select the possible range of values by pushing <RETURN>.
The data are specified by the generator as fixed values.
- Fields with [...] Input of data via the keyboard.

Error numbers which appear at the beginning of the programming procedure must be erased from the screen by pushing the <RETURN> key.

Current data files, for instance, for online help, tube types, APR programming are available in the PHILIPS-Intranet. Use path **<http://technet.best.ms.philips.com/>** and pull down menu as shown below.



If you call the installation program with <xrgscope ?> the possible starting parameters for the service program are listed.

3.2.1. Backup of all configuration data

- Switch ON the generator.

To save the configuration data use the CONFIGURATION BACKUP disk supplied.

- Save the complete SW programming of the generator on the floppy disk by using the menu:
ACCEPT/ BACKUP/ **CU complete**

A disk space of 700kByte is required.

It takes about 8min to save the data to the disk.

The default backup name:

Backup File Name: **CUBACKUP.TDL**

The name can be changed into any other filename.

The path (harddisk) is automatically taken into account.

It is also possible to type:

A: \ "filename" <RETURN>

to load the backup files directly to the floppy disk.

3.2.2. Loading the new firmware into the generator

- Switch OFF the generator.
- When installing the firmware

from COM 1 enter FLASH1.BAT

from COM 2 enter FLASH2.BAT

"Attempting link" appears on the screen.

- Switch ON the generator.

Depending on the type of PC data transmission takes 15 ... 30min.

During this process all red LEDs of the function unit are blinking.

Caution!

When the data transmission to the generator is completed, the scope program is still active. This is unfortunately not displayed on the screen. For several minutes, while the screen is blank, the flash PROMs are loaded into the generator. This process must under no circumstances be disturbed! At the end of this sensible procedure "Flash loaded o.k." appears on the screen. Only now the scope program can be terminated.

- Reset the generator.

4. Replacement of parts of "Function Unit kV"

In case one of the following assemblies:

- PCB kV-control 3 / 4 (EZ130)
- Converter (EQ)
- H.V. tank (EG)
- PCB Central unit (EZ139)

of "Function Unit kV" has been exchanged, the alignment of the "Function Unit kV" must be repeated.

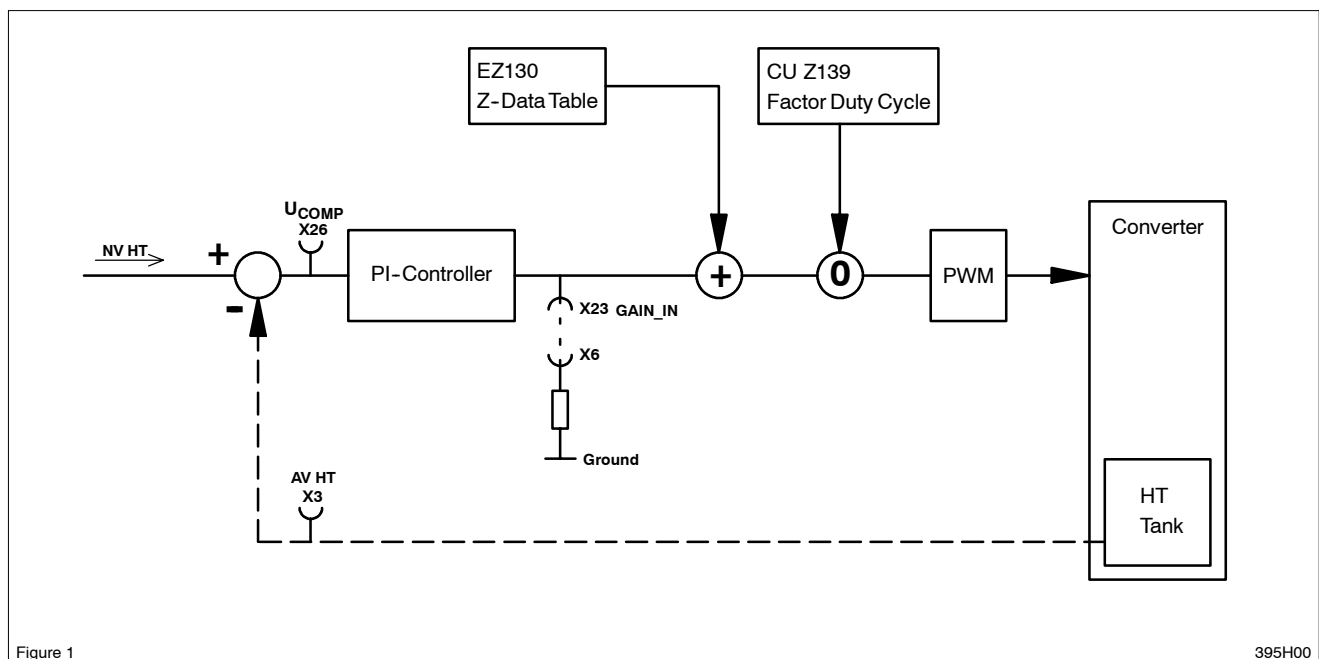
4.1. General information

The actual value of the set kV must be attained at least after 2ms. At kV rise phase there must be neither kV break-in nor a kV overshoot.

The Factor Duty Cycle is based on an adapted tube and determines at local mains voltage and mains resistance conditions:

- the kV rise phase
- the kV behavior during the exposure in falling load technique

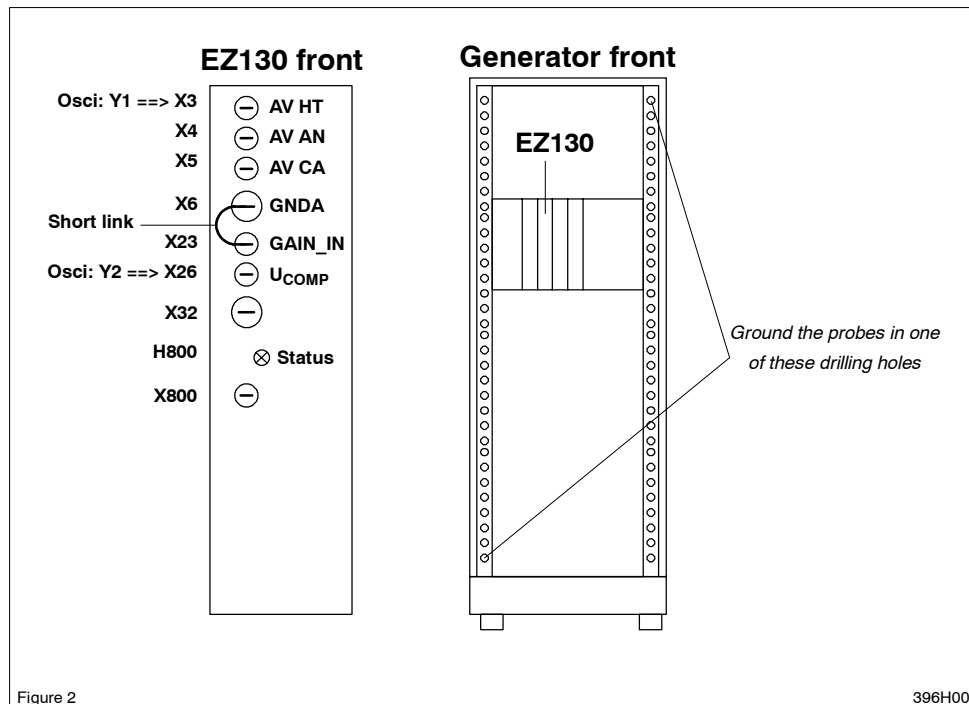
The Factor Duty Cycle is stored in the memory of PCB CU EZ139. If the CU has to be replaced the CU complete backup can be reloaded (with the actual factor) to the NVRAM memory or the Factor Duty Cycle must be re-aligned. Refer to figure 1:



During alignment this Factor Duty Cycle must be entered via XRGSCOPE. The influence of this factor as a correction value for the Z-Data Table is monitored as the U_{COMP} signal, since the PI-Controller is deactivated by the grounded $GAIN_IN$ signal.

4.2. Connecting and setting the scope

For connections see figure 2:



Channel 1 = EZ130 X3 ---> AV HT ---> 20kV/V ---> 1V/div --> Zero-line at bottom of screen
 Probe GND = one of the drilling holes at the front cabinet chassis

Channel 2 = EZ130 X26 ---> U_{COMP} ---> 1V/div ---> Zero-line 2 div from bottom of screen
 Probe GND = one of the drilling holes at the front cabinet chassis

Trigger = external (preferred) ---> CTRL_X_C/ ---> backpanel EZX74 / negative slope
 or = internal channel 1 ---> AV HT ---> EZ130 X3 / positive slope at +3V
 Probe GND = one of the drilling holes at the front cabinet chassis

Time base = 5 or 10ms/div ---> trigger delay -1div

Note

A digital scope should not have any other ground connection than the ground of the 3 probes at the drilling holes at the front generator chassis.

A mains-driven scope must be isolated from earth potential, otherwise it might display artefacts.

4.3. Deactivating the kV controller

- Connect EZ130 X23 *GAIN_IN* and X6 *GNDA* with a short link (use a short wire).

Caution!

This alignment requires exposures with high kV.

Be sure the tube has been warmed up before.

4.4. Setting of exposure data

a) Set 141kV in case of

- 65/80kW
- the tube limit (of at least one tube) is 150kV perform this adjustment at the tube which has the highest kV limit programmed.

b) Set 125kV in case of

- 50kW
- and
- 65/80kW if the programmed application limit of the tube limit is 125kV.

Note

Any tube arcing during this adjustment requires the execution of the tube conditioning next as described in section 2 "INSTALLATION".

Disconnect the short link between X23 and X6.

Start over this adjustment from chapter 2.3 onwards if the tube conditioning was successful.

- Set kV and mA values according to the programmed tube limits:

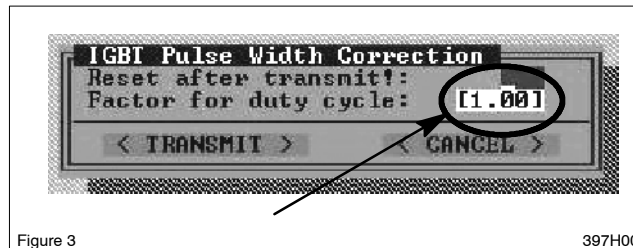
a) 141kV: 200mA at kV_4 (65/80kW)

b) 125kV: 100mA at kV_3 (50kW)
 200mA at kV_4 (65/80kW)

- Set exposure time: 40ms

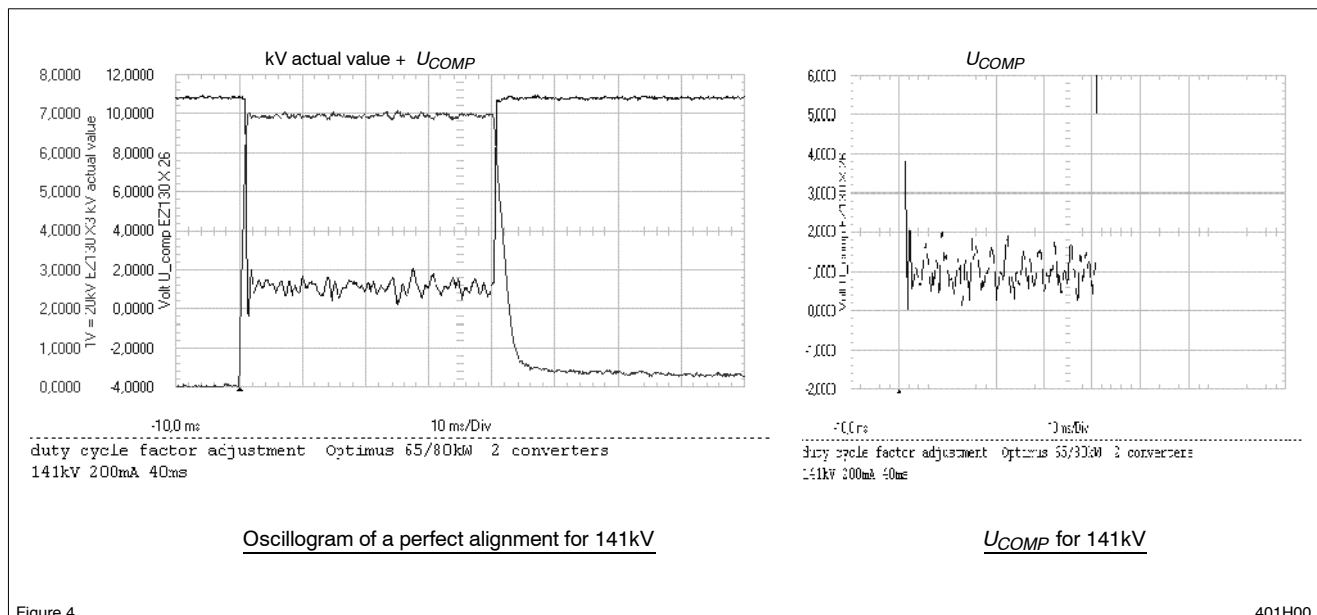
4.5. Adjustment of the "factor for duty cycle"

- Adjust the Factor Duty Cycle via service software XRGSCOPE by measuring U_{COMP} with the scope.
- Connect the service PC and start XRGSCOPE:
XRGSCOPE
SELECT UNIT ---> FU-kV ---> ADJUST ---> IGBT Pulse Width Correction ---> Factor Duty Cycle
- Set the starting value Factor Duty Cycle to **1.00**:



- If the U_{COMP} value does not match the requirements type in another Factor Duty Cycle value, <TRANSMIT> the screen and push the active RGDV button to get the new value validated.
- Switch an exposure.
The values are measured in the stationary condition. The transient behavior at the beginning of the exposure is not taken into account.

Result: In standby the U_{COMP} value is at about +11V, during exposure the mean value U_{COMP} must be as given in table 1 or 2, refer to figure 4:



a) 141kV setting (65/80kW only)

- Read the mean value of U_{COMP} for 141kV (see scope figure 4 or 5), correct the Factor Duty Cycle till U_{COMP} meets the required reference of +1V.

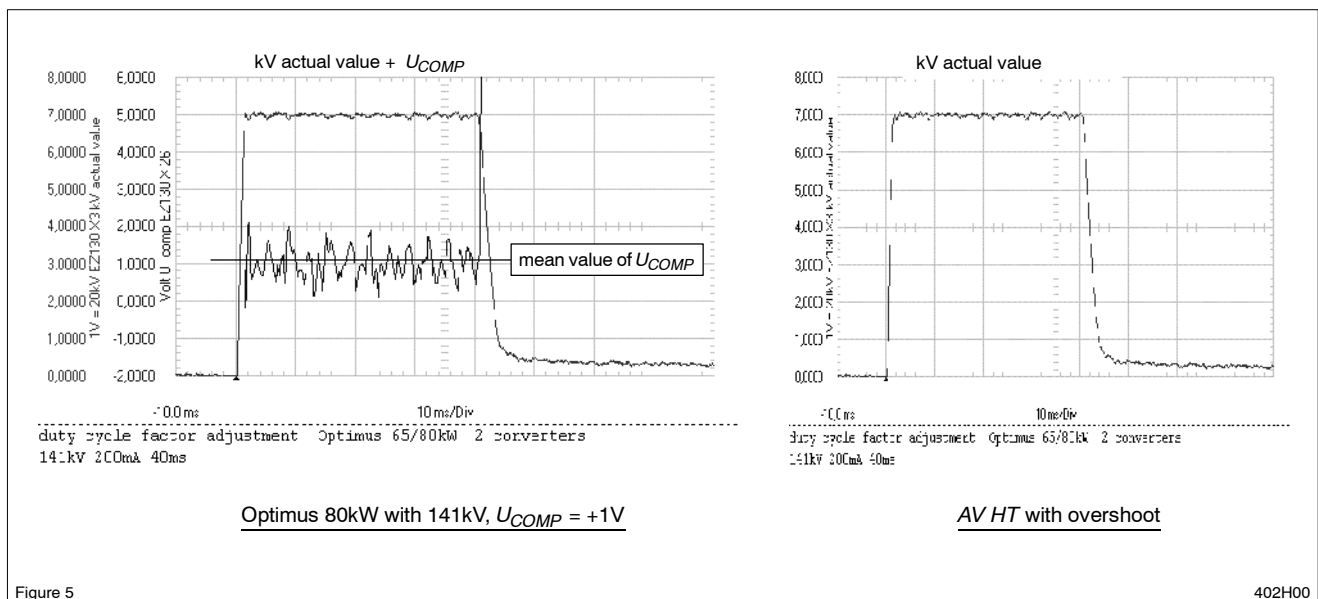
kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of AV HT	Factor Duty Cycle:	Date:
141kV	200mA	PCB kV_control 4:	+1V	±0.5V	138kV		

Table 1: Factor Duty Cycle, settings 141kV (150kV limit)

Example how to correct the Factor Duty Cycle:

PCB kV_control 4:

- If the mean value of U_{COMP} is:
 > +1.5V **increase** the Factor Duty Cycle in steps of 0.01
 < +0.5V **decrease** the Factor Duty Cycle in steps of 0.01
- Check also the kV peak value AV HT (not the overshoot), it must be **138kV** for **141kV** setpoint. (see scope figure 5)
- Remove short link EZ130 X23 GAIN_IN.
- Record the findings in table1.



b) 125kV setting (50/65/80kW)

- Read the mean value of U_{COMP} for 125kV (in principle figure 4 or 5).
- Correct the Factor Duty Cycle till U_{COMP} meets the required reference of 0V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of AV HT	Factor Duty Cycle:	Date:
125kV	100mA	PCB kV_control 3:	+0V	+1V / -0,5V	125kV		
125kV	200mA	PCB kV_control 4:	+0V	±0.5V	125kV		

Table 2: Factor Duty Cycle, 125kV limit

Example how to correct the Factor Duty Cycle:

PCB kV control 3:

- If the mean value of U_{COMP} is:
 - $> +1V$ **increase** the Factor Duty Cycle in steps of 0.01
 - $< -0.5V$ **decrease** the Factor Duty Cycle in steps of 0.01

PCB kV_control 4:

- If the mean value of U_{COMP} is:

$> +0.5V$ increase the Factor Duty Cycle in steps of 0.01 $< -0.5V$ decrease the Factor Duty Cycle in steps of 0.01
--
- Check also the kV peak value AV_{HT} (not the overshoot), it must be **125kV** for **125kV** setpoint.
- Remove short link EZ130 X23 $GAIN_IN$.
- Record the findings in table 2.

5. Tube replacement

Any new tube require a new adjustment procedure consisting of:

1. Tube conditioning
2. Tube adaptation



Warning!
Radiation is released during the adjustment procedure!

The generator must be in the **READY** state, i.e. the green ring at the desk must be illuminated!

5.1. Tube conditioning

- Select free cassette auxiliary.
- Select **large** focus only.

Note

The generator must be in the READY state.

- Run conditioning procedure for a new or non-adapted tube, refer to following table “Exposure parameters for conditioning”.
- It is recommended that the high tension be monitored during conditioning.
Connect the scope:
 Channel1: kV AV HT at EZ130 X3 (1V/div), scale: 20kV/V
 Trigger external: CTRL_X_C/ at backpanel EZ X74, negative slope
 Time base: 2ms/div
- In case of problems like tube arcing see the following flowchart EXPOSURE SEQUENCE as an example.
The flowchart applies for applicable kV range only, e. g.:
109kV is the max. kV value for normal application, perform just up to next higher kV step = 117kV.

Note

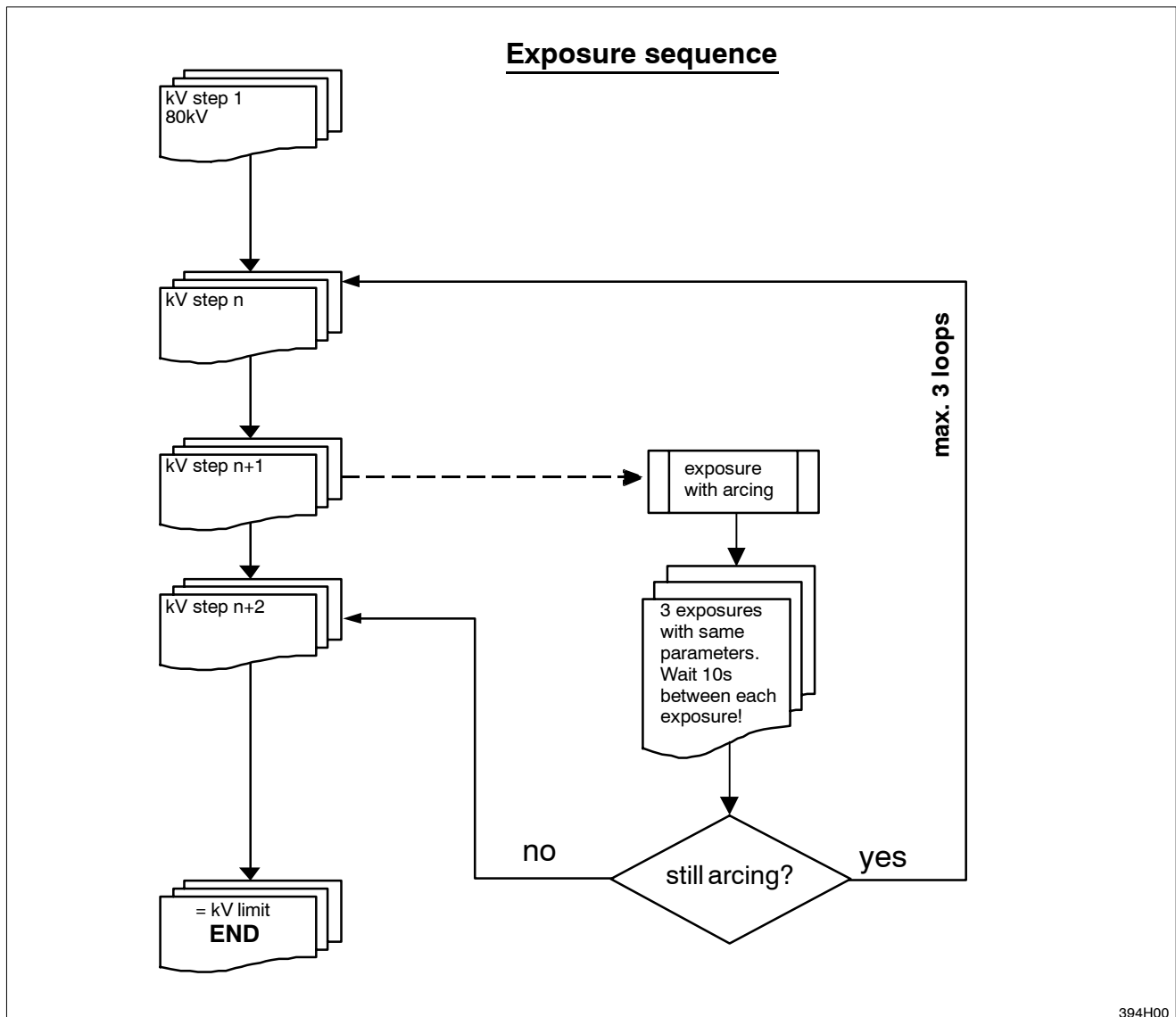
Refer to flowchart EXPOSURE SEQUENCE.

If the tube arcs at a certain kV value, switch another 3 exposures with same parameters and 10s pause between subsequent exposures. In case of success (no arcing anymore) continue with next kV step of the following table.

*If the last exposure still arcs go one kV step back and follow normal procedure. If this routine has been performed three times without improvement: ==> **Replace the tube!***

Exposure parameters for conditioning		
kV	mAs	# exposures
80	0.5	< 1 >
80	5	< 1 >
80	50	< 1 >
10 seconds pause		
80	100	< 1 >
1 minute pause		
90	0.5	< 1 >
90	5	< 1 >
90	50	< 1 >
10 seconds pause		
90	100	< 1 >
1 minute pause		
100	0.5	< 1 >
100	5	< 1 >
100	50	< 1 >
10 seconds pause		
100	100	< 1 >
1 minute pause		
110	0.5	< 1 >
110	5	< 1 >
110	50	< 1 >
10 seconds pause		
110	100	< 1 >
1 minute pause		
120	0.5	< 1 >
120	5	< 1 >
120	50	< 1 >
10 seconds pause		
120	100	< 1 >
1 minute pause		
130	0.5	< 1 >
130	5	< 1 >
130	50	< 1 >
10 seconds pause		
130	100	< 1 >
1 minute pause		

Exposure parameters for conditioning		
kV	mAs	# exposures
140	0.5	< 1 >
140	5	< 1 >
140	50	< 1 >
10 seconds pause		
140*	100	< 1 >
1 minute pause		
145	0.5	< 1 >
145	5	< 1 >
145	50	< 1 >
10 seconds pause		
145	100	< 1 >
1 minute pause		
148	0.5	< 1 >
148	5	< 1 >
148	50	< 1 >
10 seconds pause		
148	100	< 1 >
1 minute pause		
150	0.5	< 1 >
150	5	< 1 >
150	50	< 1 >
10 seconds pause		
150	100	< 1 >
1 minute pause		

**Note**

If a tube arcs at any kV value which is not required for application the max. kV (e.g. 117kV) program this new limit value by XRGSCOPE:

PROGRAM/ TUBES/ TUBE LIMITS/ MAX. TUBE VOLTAGE LIMIT [kV]/ [117]

As the limit value decreases for this reason, a following re-adaptation procedure sets the field ADAPTED TO [kV] to this value as well.

- Set RGDV programming to original status if no adaptation procedure has to be executed.
- RESET the generator.

5.2. Tube adaptation

5.2.1. General information

Tube adaptation is an automatic process which includes:

1. The measurement of the mA offset value that is caused by:
 - the kV measuring circuit
 - the emission current feedback circuit (VCO)
2. The measurement of the individual standby filament current (based on 100 μ A).
3. The emission current characteristic as f (kV, filament current).
4. The dynamic behavior (positive and negative boost adaptation) where the inertia of the filament with respect to heating up and cooling down is registered.
For more information refer to section 3: FAULT FINDING.

Note

In case of problems check the symptom / solution list at the end of this adjustment chapter. Repeat the adaptation for this particular focus.

5.2.2. Procedure

Note

*The tube must be properly conditioned before starting the adaptation procedure.
For break-in procedure see previous chapter 8.2.1. "Tube conditioning".*

Tube adaptation is an automatic process which includes:

1. The measurement of the mA offset of
 - the kV measuring circuit.
 - the emission current voltage / frequency converter.
2. The measurement of the individual standby filament current.
3. The kV dependent filament / emission current behavior.
4. The boost adaptation to calculate the positive and negative boost in one procedure.
For more information refer to section 3: FAULT FINDING.

Note

*In case of problems check the symptom / solution list at the end of this chapter.
Repeat the adaptation for this particular focus.*

- Press **<RETURN>**.
An opening screen asks to wait 20 seconds after the screen comes up.
- Thereafter the data has been transmitted by pressing **<F2>**.

Tube: **1st Tube**
 2nd Tube not applicable
 3rd Tube not applicable

Focus: **small**
 medium a tube with a (third) medium filament does not exist yet, it is **not** VARIOFOCUS
 large

After data transmission COCKPIT displays [**Adaptation X-Ray tube**] (locally programmed language).
READY returns (waiting time is in the order of 15 seconds).

- Push <**PREP**> and <**EXP**> button at the control desk or use footswitch.

The generator switches about 125 exposures for each focus.

The radiation sign at the desk indicates exposures and a beep is audible at the end of every exposure.

There is no display of the actual kV parameters during adaptation.

The termination of the adaptation procedure will be indicated at the PC screen and a beep from the PC is audible.

- RESET the generator.
- Adapt **both** small and large focus to use VARIOFOCUS.
APRs using VARIOFOCUS cannot be selected as long as **both**, small and large are not adapted.
The COCKPIT screen indicates a non-adapted focus.

5.3. Symptoms and solutions if problems occur during tube adjustment

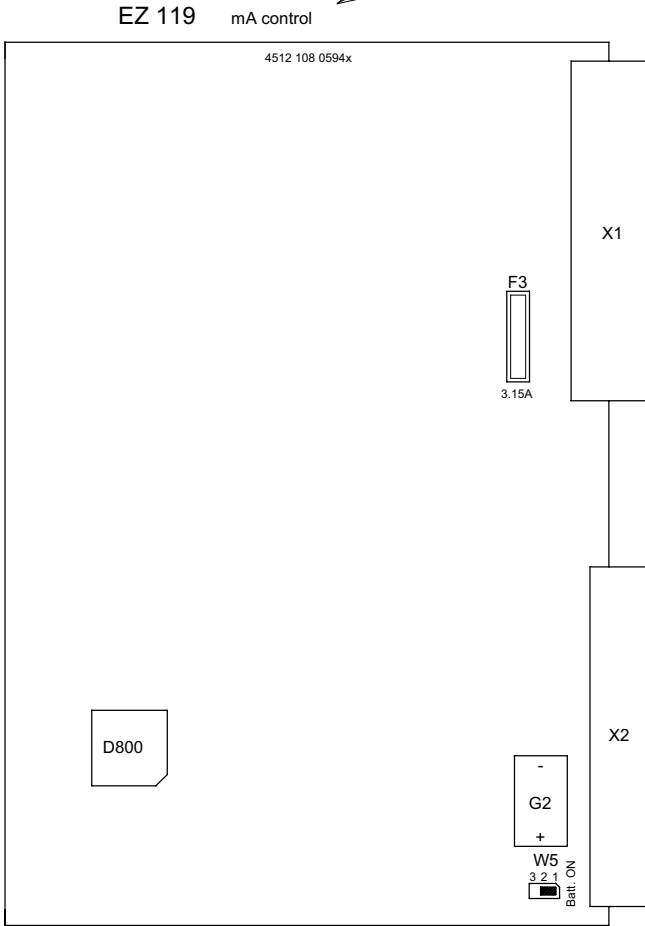
1. A warning can not be displayed on the control desk, the WAITING screen on the PC is flickering instead during this event and logged in the error log index.
2. If the tube has already been in a high temperature level (but the traffic light still indicates green or green-yellow for 100% power) it might happen that the traffic light changes straight to red and the adaptation is on hold. WAITING is flickering on the PC.
Solution: Keep the handswitch pushed, once the temperature is down adaptation continues automatically.

Note

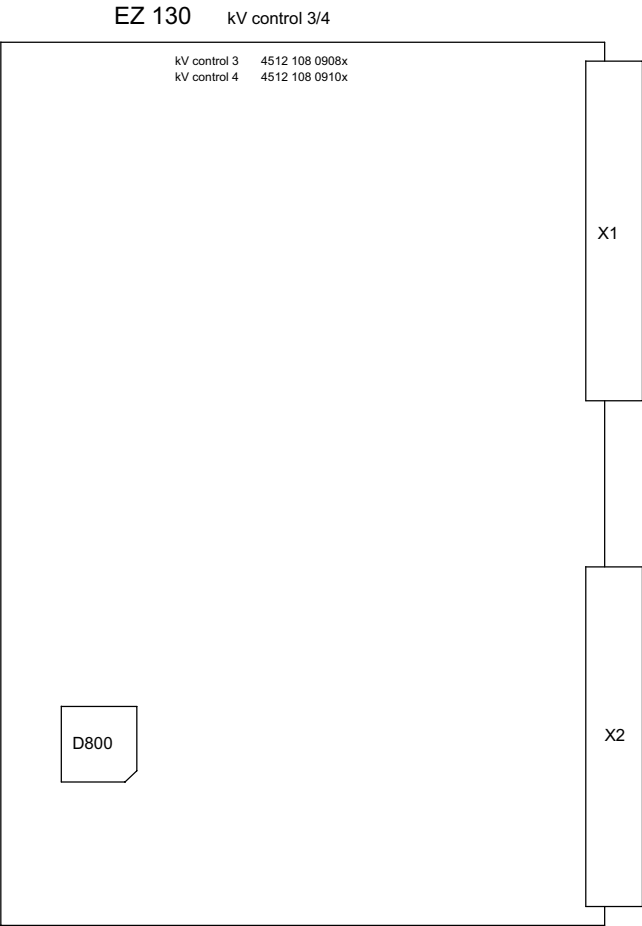
An increment of one of the temperature levels inhibits the 100% power condition. This event is always logged as warning 00BV in the error log index.

3. An error message just flashes for a very short moment and instantly covered by ADAP on the desk afterwards. WAITING is flickering on the PC.
4. All buttons at the control desk including the RESET button are inactive during adaptation.
The only way to RESET an error is to release the PREP switch which causes an interrupt similar to the RESET command.
5. After let go of the PREP switch wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.
6. If adaptation seems to do nothing for more than 30 seconds let go the PREP switch. Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.
7. If a constant READY indication appears for more than 2 seconds while PREP and EXP is activated by the handswitch during adaptation let go the handswitch.
Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.
8. If adaptation does not carry on with or without READY indication check whether one of the function units indicates a FATAL error by turning on the red LED. Let go the handswitch and warmstart the generator by pushing the RESET button on CU EZ139.
9. If adaptation has been interrupted by a generator warmstart check the error log index before restarting adaptation:
kV errors 02WG and/or 02WH indicate tube arcing. Run conditioning of the tube as described in section 2 "INSTALLATION" and/or reduce the max. kV value to the required application value.

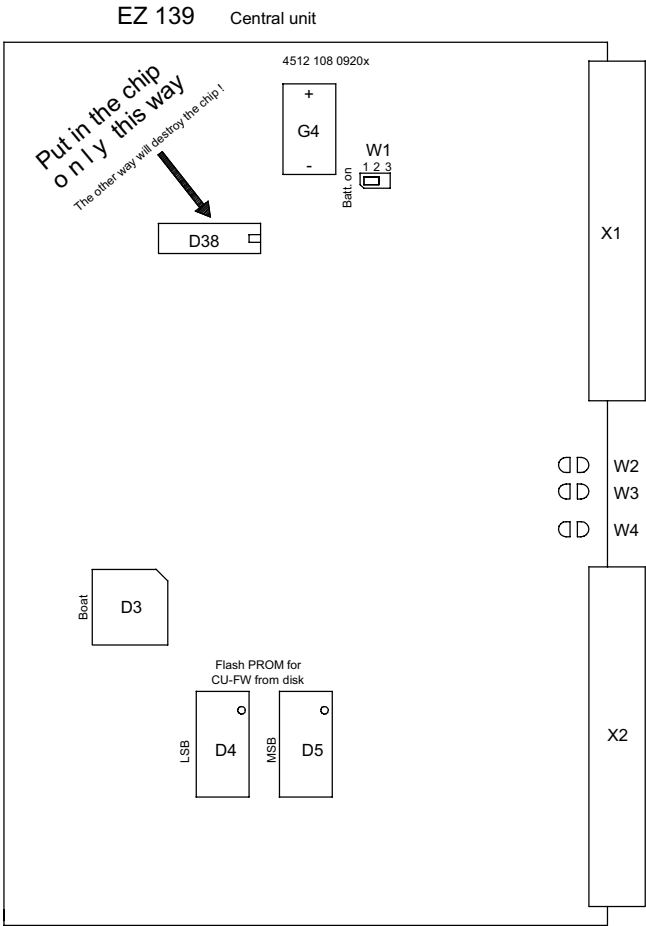
Attention: Do not forget to set the jumper
of the battery in the position "Batt. ON":
EZ119: W5
EZ139: W1



D800 = 4512 113 20211
= 4512 113 20212



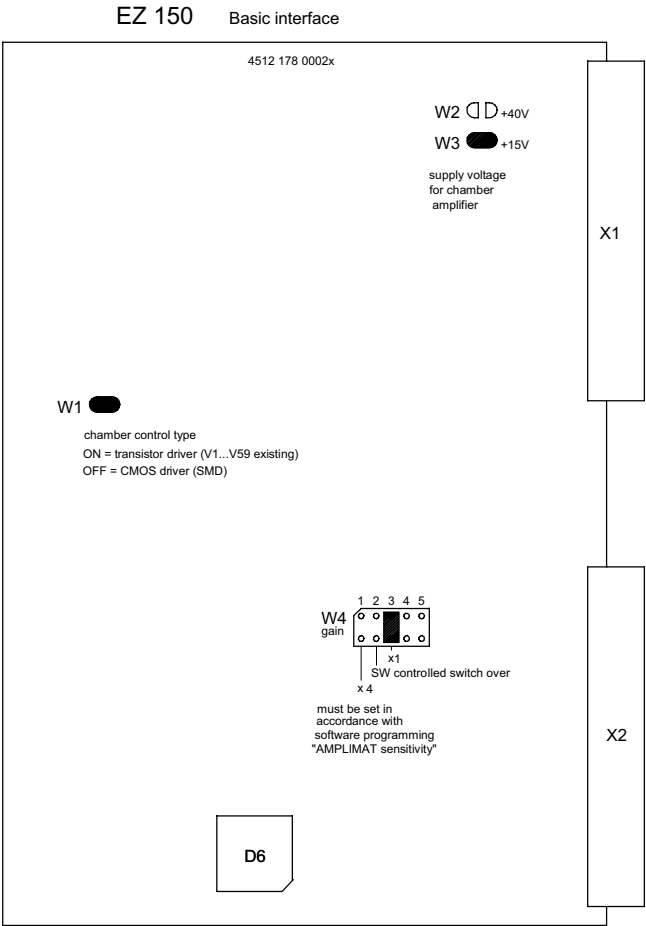
D800 = 4512 113 20132 RAD
D800 = 4512 113 26212 R/F



D38 = function key,
marked with s/n of the generator

OPTIMUS R/F :
OPTIMUS RAD :

Boot- FW D3 = 4512 113 20731
Cu - FW Rel 3.5 = 9890 000 02512 (4512 114 20835)
Cannot be ordered. Use OMA0220x. exe disk for flash PROM loading.



PCB layout print different from figure.

D6 = 4512 113 20311

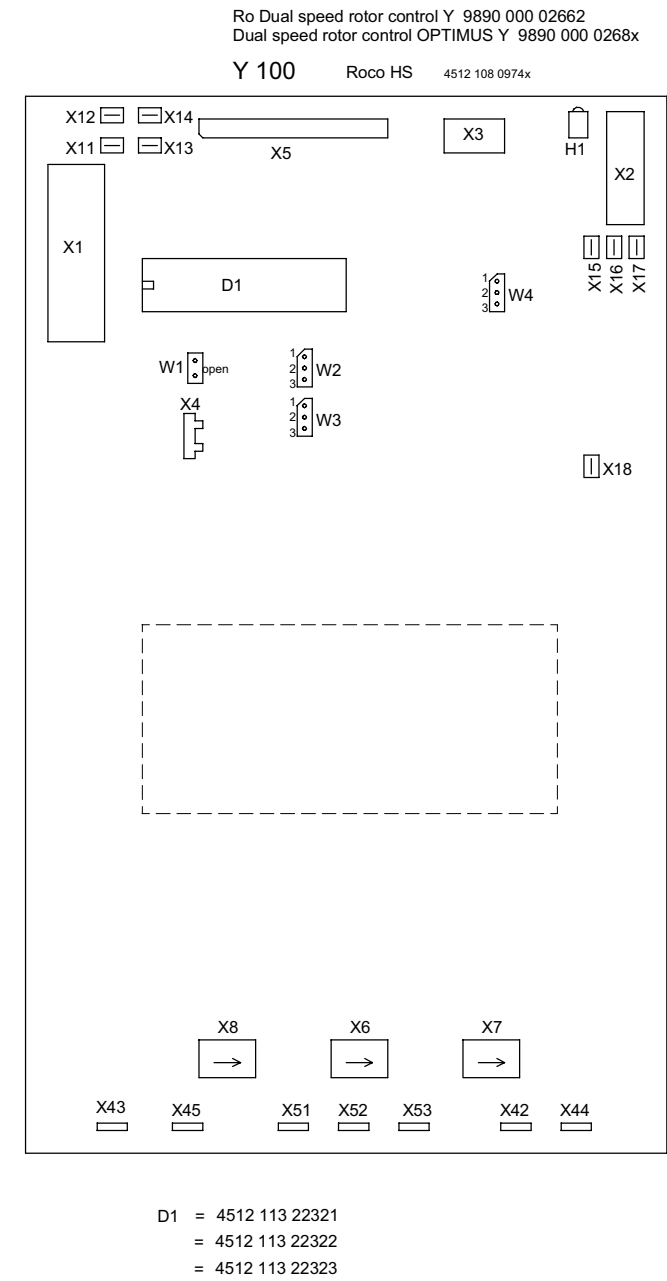
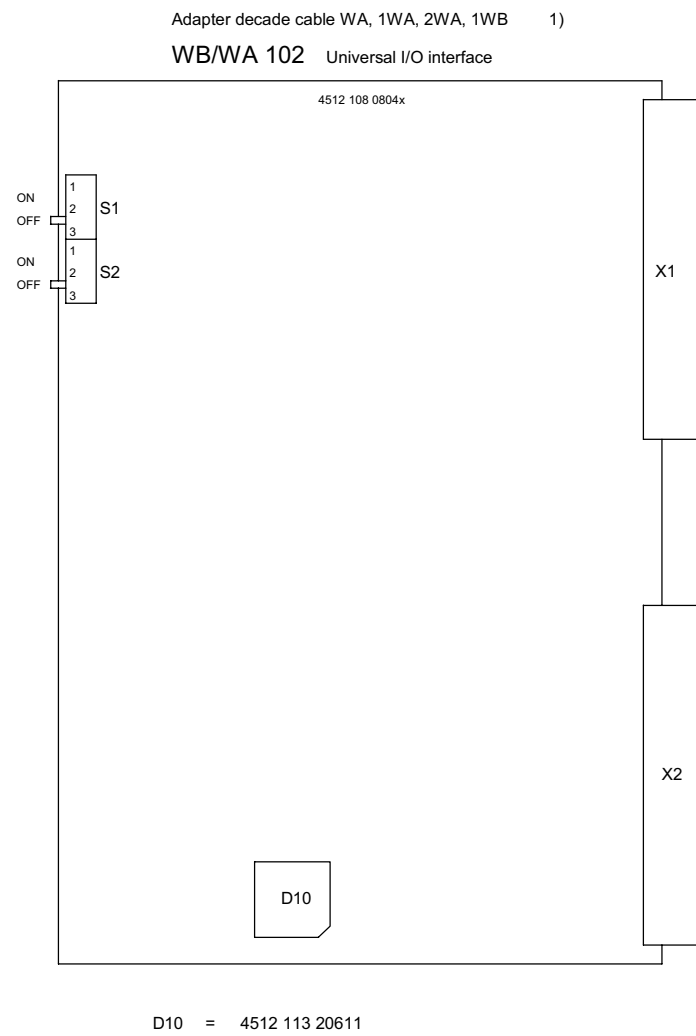
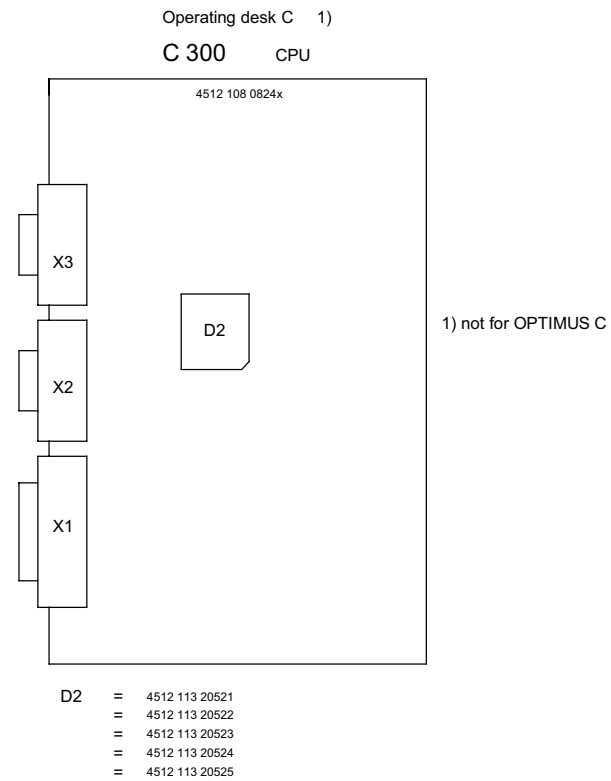
kV control 3 \geq 4512 108 09081
kV control 4 \geq 4512 108 09101

- OPTIMUS R/F
D800 = 4512 113 26211
= 4512 113 26212
- OPTIMUS RAD
D800 = 4512 113 20131
= 4512 113 20132

OPTIMUS C :

Boot- FW D3 = 4512 113 27001
Cu - FW Rel 1 = 9890 000 02541 (4512 114 26901)
Cannot be ordered. Use OMC0241x. exe disk for flash PROM loading.

PCB programming
central rack EZ



Coding	Rotor control	
	1st	2nd
W2		
W3		

W4	Application of RoCo HS
1O 2O open 3O	normal
1O 2O 2 - 3 3O closed	MRC solo

ADJUSTMENTS

TEXT

Contents	6-0.1
1. Alignment of "Function Unit kV"	6-1
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1. Alignment of “Function Unit kV”

1.1. General information

The actual value of the set kV must be attained at least after 2ms. At kV rise phase there must be neither kV break-in nor a kV overshoot.

The Factor Duty Cycle is based on an adapted tube and determines at local mains voltage and mains resistance conditions:

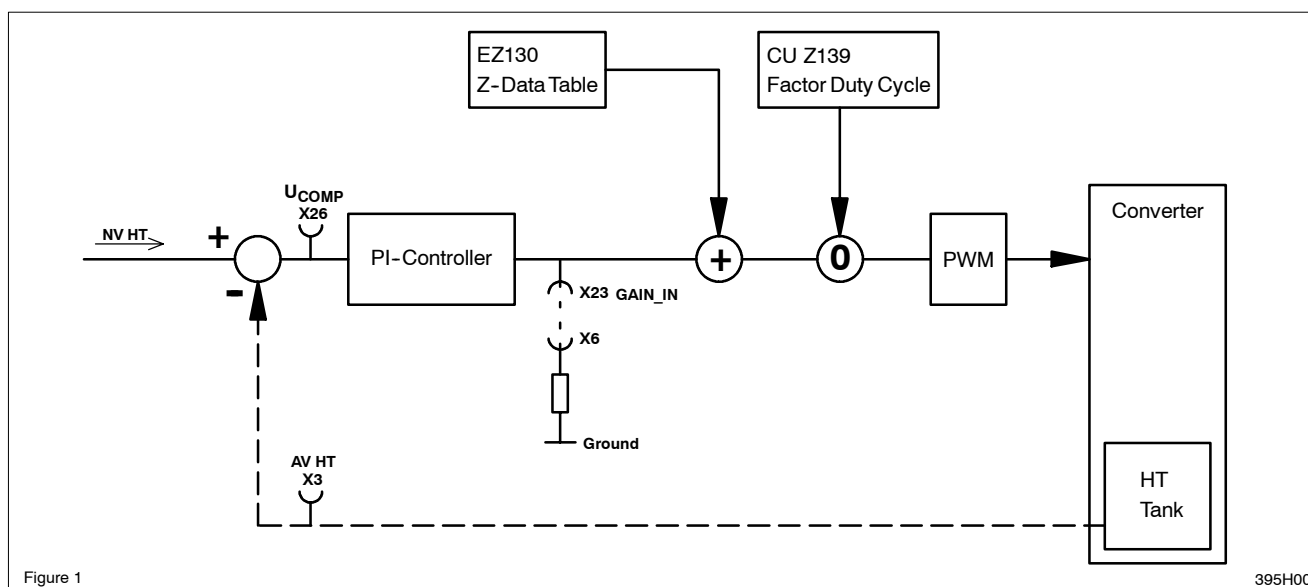
- the kV rise phase
and
- the kV behavior during the exposure in falling load technique

as it takes into account the tolerances of the following FRUs (Field Replaceable Units):

1. PCB EZ 130 **
 kV_control_3 = 50kW 1 converter 4512 108 0908x
 kV_control_4 = 65/80kW 2 converters 4512 108 0910x
2. A complete power converter unit Q **
 kV_power PCB(s) Q100 (part of the power converter unit)
 IGBT transistors (part of the power converter unit)
3. Resonance capacitors (part of the power converter unit) **
4. High tension transformer **

An exchange of one of the ** marked parts requires a realignment of the Factor Duty Cycle.

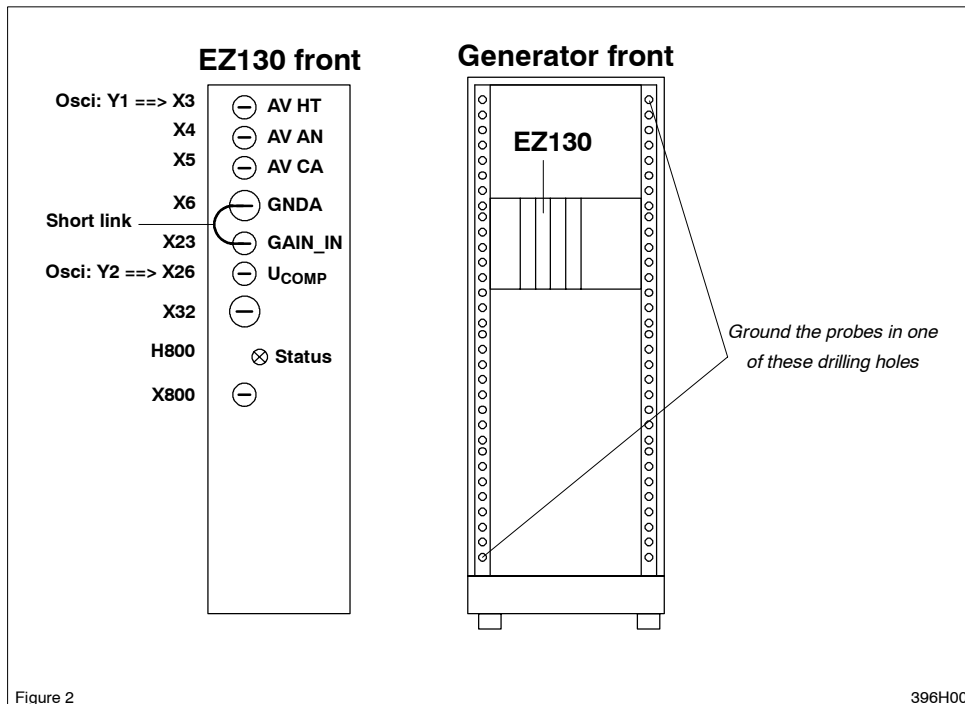
The Factor Duty Cycle is stored in the memory of PCB CU EZ139. If the CU has to be replaced the CU complete backup can be reloaded (with the actual factor) to the NVRAM memory or the Factor Duty Cycle must be re-aligned. Refer to figure 1:



During alignment this Factor Duty Cycle must be entered via XRGSCOPE. The influence of this factor as a correction value for the Z-Data Table is monitored as the U_{COMP} signal, since the PI-Controller is deactivated by the grounded $GAIN_IN$ signal.

1.2. Connecting and setting the scope

For connections see figure 2:



Channel 1 = EZ130 X3 ----> AV HT ----> 20kV/V ----> 1V/div --> Zero-line at bottom of screen
 Probe GND = one of the drilling holes at the front cabinet chassis

Channel 2 = EZ130 X26 ----> U_{COMP} ----> 1V/div ----> Zero-line 2 div from bottom of screen
 Probe GND = one of the drilling holes at the front cabinet chassis

Trigger = external (preferred) ----> CTRL_X_C/ ----> backpanel EZX74 / negative slope
 or = internal channel 1 ----> AV HT ----> EZ130 X3 / positive slope at +3V
 Probe GND = one of the drilling holes at the front cabinet chassis

Time base = 5 or 10ms/div ----> trigger delay -1div

Note

A digital scope should not have any other ground connection than the ground of the 3 probes at the drilling holes at the front generator chassis.

A mains driven scope must be isolated from earth potential, otherwise it might display artefacts.

1.3. Deactivating the kV controller

- Connect EZ130 X23 *GAIN_IN* and X6 *GNDA* with a short link (use a short wire).

Caution!

This alignment requires exposures with high kV.

Be sure the tube has been warmed up before.

1.4. Setting of exposure data

a) Set 141kV in case of

- 65/80kW
- the tube limit (of at least one tube) is 150kV perform this adjustment at the tube which has the highest kV limit programmed.

b) Set 125kV in case of

- 50kW
and
- 65/80kW if the programmed application limit of the tube limit is 125kV.

Note

Any tube arcing during this adjustment requires the execution of the tube conditioning next as described in section 2 "INSTALLATION".

Disconnect the short link between X23 and X6.

Start over this adjustment from chapter 2.3 onwards if the tube conditioning was successful.

- Set kV and mA values according to the programmed tube limits:

a) 141kV: 200mA at kV_4 (65/80kW)

b) 125kV: 100mA at kV_3 (50kW)
 200mA at kV_4 (65/80kW)

- Set exposure time: 40ms

1.5. Adjustment of the "factor for duty cycle"

- Adjust the Factor Duty Cycle via service software XRGSCOPE by measuring U_{COMP} with the scope.
- Connect the service PC and start XRGSCOPE:
XRGSCOPE
SELECT UNIT ---> FU-kV ---> ADJUST ---> IGBT Pulse Width Correction ---> Factor Duty Cycle
- Set the starting value Factor Duty Cycle to **1.00**:

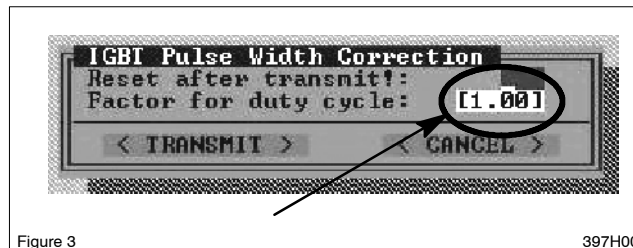


Figure 3

397H00

- If the U_{COMP} value does not match the requirements type in another Factor Duty Cycle value, <TRANSMIT> the screen and push the active RGDV button to get the new value validated.
- Switch an exposure.
The values are measured in the stationary condition. The transient behavior at the beginning of the exposure is not taken into account.

Result: In standby the U_{COMP} value is at about +11V, during exposure the mean value U_{COMP} must be as given in table 1 or 2, refer to figure 4:

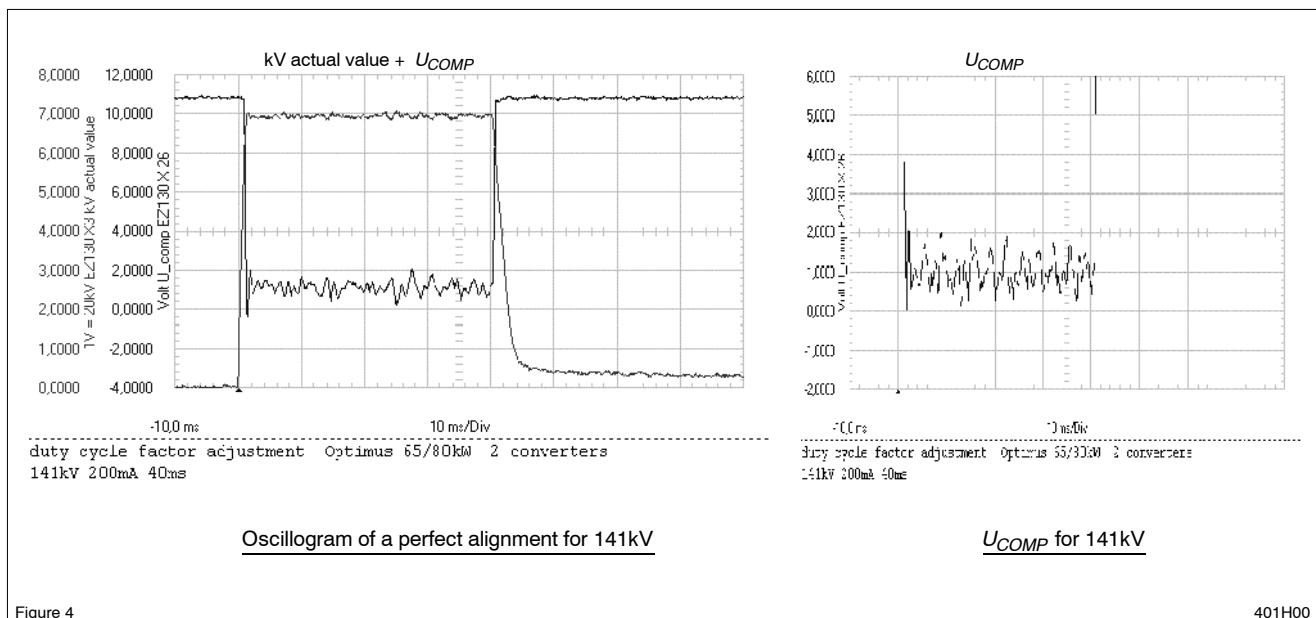


Figure 4

401H00

a) 141kV setting (65/80kW only)

- Read the mean value of U_{COMP} for 141kV (see scope figure 4 or 5), correct the Factor Duty Cycle till U_{COMP} meets the required reference of +1V.

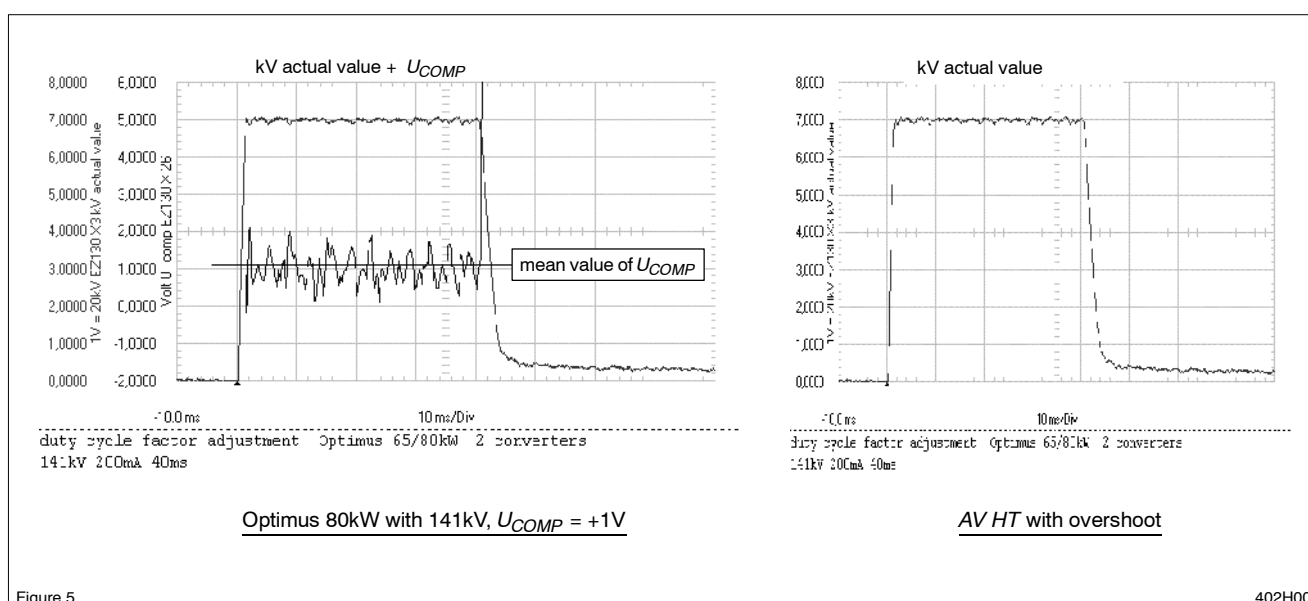
kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of AV HT	Factor Duty Cycle:	Date:
141kV	200mA	PCB kV_control 4:	+1V	±0.5V	138kV		

Table 1: Factor Duty Cycle, settings 141kV (150kV limit)

Example how to correct the Factor Duty Cycle:

PCB kV_control 4:

- If the mean value of U_{COMP} is:
 > +1.5V **increase** the Factor Duty Cycle in steps of 0.01
 < +0.5V **decrease** the Factor Duty Cycle in steps of 0.01
- Check also the kV peak value AV HT (not the overshoot), it must be **138kV** for **141kV** setpoint. (see scope figure 5)
- Remove short link EZ130 X23 GAIN_IN.
- Record the findings in table1.



b) 125kV setting (50/65/80kW)

- Read the mean value of U_{COMP} for 125kV (in principle figure 4 or 5).
- Correct the Factor Duty Cycle till U_{COMP} meets the required reference of 0V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of AV HT	Factor Duty Cycle:	Date:
125kV	100mA	PCB kV_control 3:	+0V	+1V / -0,5V	125kV		
125kV	200mA	PCB kV_control 4:	+0V	±0.5V	125kV		

Table 2: Factor Duty Cycle, 125kV limit

Example how to correct the Factor Duty Cycle:

PCB kV control 3:

- If the mean value of U_{COMP} is:
 - $> +1V$ **increase** the Factor Duty Cycle in steps of 0.01
 - $< -0.5V$ **decrease** the Factor Duty Cycle in steps of 0.01

PCB kV_control 4:

- If the mean value of U_{COMP} is:

$> +0.5V$ increase the Factor Duty Cycle in steps of 0.01 $< -0.5V$ decrease the Factor Duty Cycle in steps of 0.01
--
- Check also the kV peak value AV_{HT} (not the overshoot), it must be **125kV** for **125kV** setpoint.
- Remove short link EZ130 X23 *GAIN_IN*.
- Record the findings in table 2.

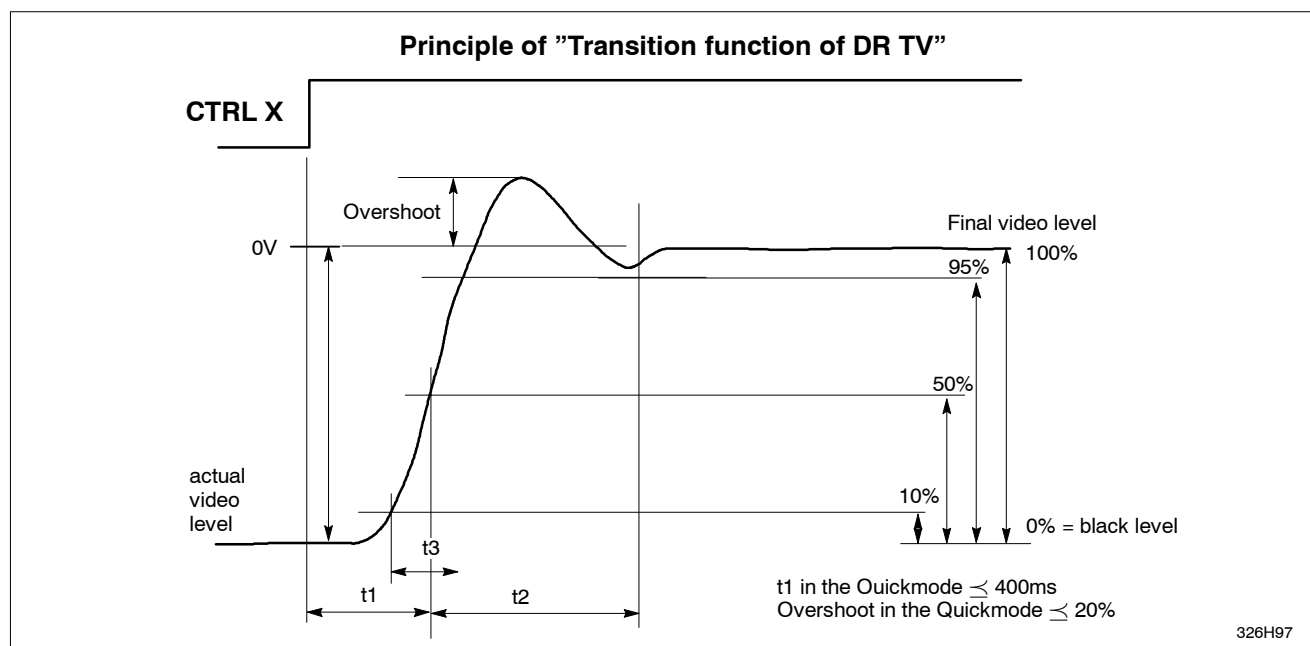
2. Dose rate alignment for continuous fluoroscopy when using the dose-rate signal DR TV (formerly ADC) // dose-rate control via TV-chain

2.1. Aim

The amplification factor of the control circuit must be adjusted such that

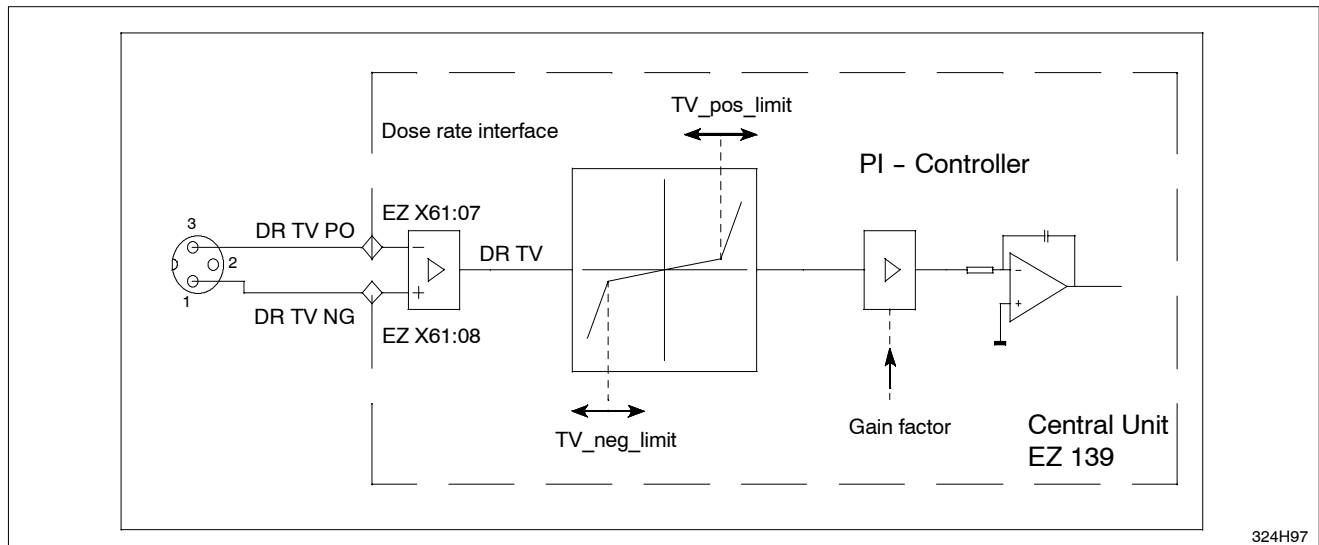
- the TV image becomes visible within about 400ms after fluoroscopy is switched ON with RQXGFL
- there is no flashing of the TV image (overshoot < 20%).

Also see sketch below:



2.2. Principle

Adjusting value : Transition function of DR TV
 Variables : TV_pos_limit / TV_neg_limit / Gain factor



324H97

- Set the gain factor to default value = 1.00 with FW XRGSCOPE:

OPTIMUS

--> Adjustments

--> Dose rate control

--> Amplification gain

--> CONT

Gain factor 0.5...2 (default = 1): [1.000]

- With fluoroscopy **switched OFF**, measure the black level of the dose-rate signal of the TV chain.
Suitable test points:
 - WN 25 DRDFP (with a TV chain XTV 11)
 - (EZ X61:7 = DR TV PO)

The kink of the characteristic curve TV_pos_limit to be adjusted must be:

TV_pos_limit = DR TV PO (black level measured) - 500mV

Example: DR TV PO = 7.3V → adjusting value TV_pos_limit = 6.8V

- Set TV_pos_limit via XRGSCOPE:

OPTIMUS

--> Program

--> Dose rate control

--> **CONT:**

Program settings for continuous fluoroscopy:

+ ----- CONT_MOD.TDL ----- +	
| scantime_TV [ms]: [20.000] |	→ 50Hz = 20ms
| scantime_TV valid: Yes <input type="checkbox"/>	→ yes with control via TV chain. With photo diode = no.
| P_max_EDL [W]: [250] |	→ 250 default: Effective only when SID WB X12:1 DRLM is switched ON.
| TV_pos_limit [V]: [6.8] |	→ DR TV PO - 500mV. (TV black voltage - about 500mV)
| TV_neg_limit [V]: [-6.8] |	→ = - TV_pos_limit [V]

| < OK > |	

In case the switch ON procedure is fast enough with this setting

$T1 \leq 400\text{ms}$ in quick mode or $T1 \leq 500\text{ms}$ in normal mode

and the TV chain does not flash when fluoroscopy is switched ON,

overshoot $\leq 20\%$

the alignment with the oscilloscope described below is **not** required.

2.3. Alignment of DR TV with the oscilloscope

Settings of the oscilloscope:

Y1 to EZ 150 X6 : EN X C/ [10V/div]
 Y2 e.g. with XTV11
 to WN 25 : DRDFP [5V/div]
 Ground to EZ 150 X5 : GNDA
 Time base : 200ms/div
 Trigger : Y1 / - DC

The alignment should not be carried out in the quick mode since the differences of the transition functions are not big enough in the quick mode. However, in the normal mode the overshoot is slightly higher than 20%.

Since fluoroscopy is automatically in the quick mode for up to 30s after the end of fluoroscopy, after each oscillogram fluoroscopy must be switched OFF for at least 30s:

Pause > 30s → Fluoro ON → Oscillogram → Fluoro OFF
 → Pause > 30s → Fluoro ON → Oscillogram → Fluoro OFF
 → ...

Fluoroscopy adjustments for all oscillograms:

- Dark voltage of the TV chain measured: DR TV $PO_{\text{dark}} = 7.3\text{V}$

XRGSCOPE:

OPTIMUS

--> Program

--> Dose rate control

--> **CONT:**

scantime_TV [ms] : 20.000 (→ 50Hz)
 scantime_TV valid : Yes
 P_max_EDL [W] : 250

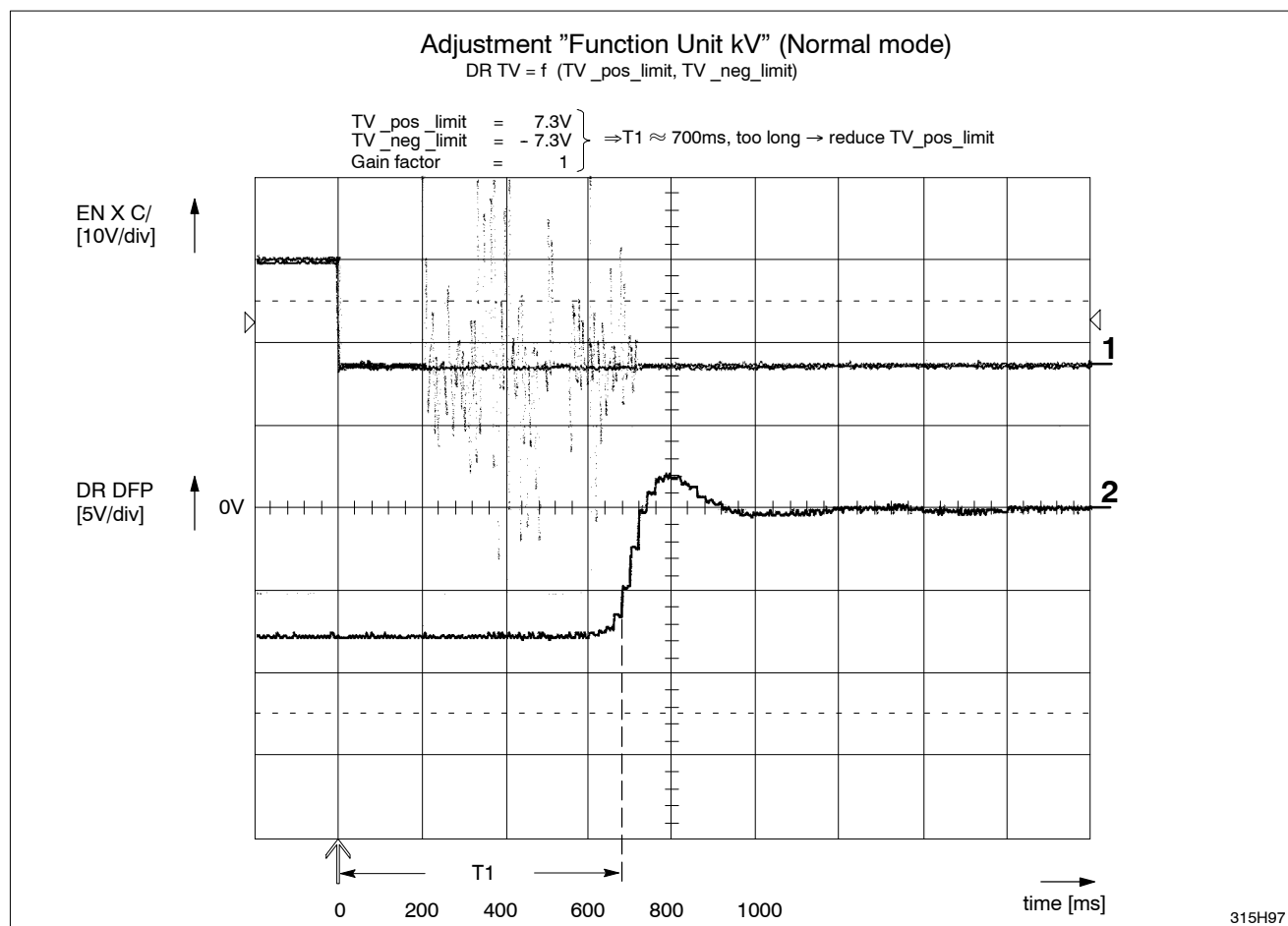
Operating point of fluoroscopy in the automatic mode (example XTV 11):

- 9" I.I. format
- Filter in the path of radiation: 1.5mmCu + 20mmAl ==> 74kV / 2.2mA

First reference oscillogram:

Values adjusted with XRGSCOPE:

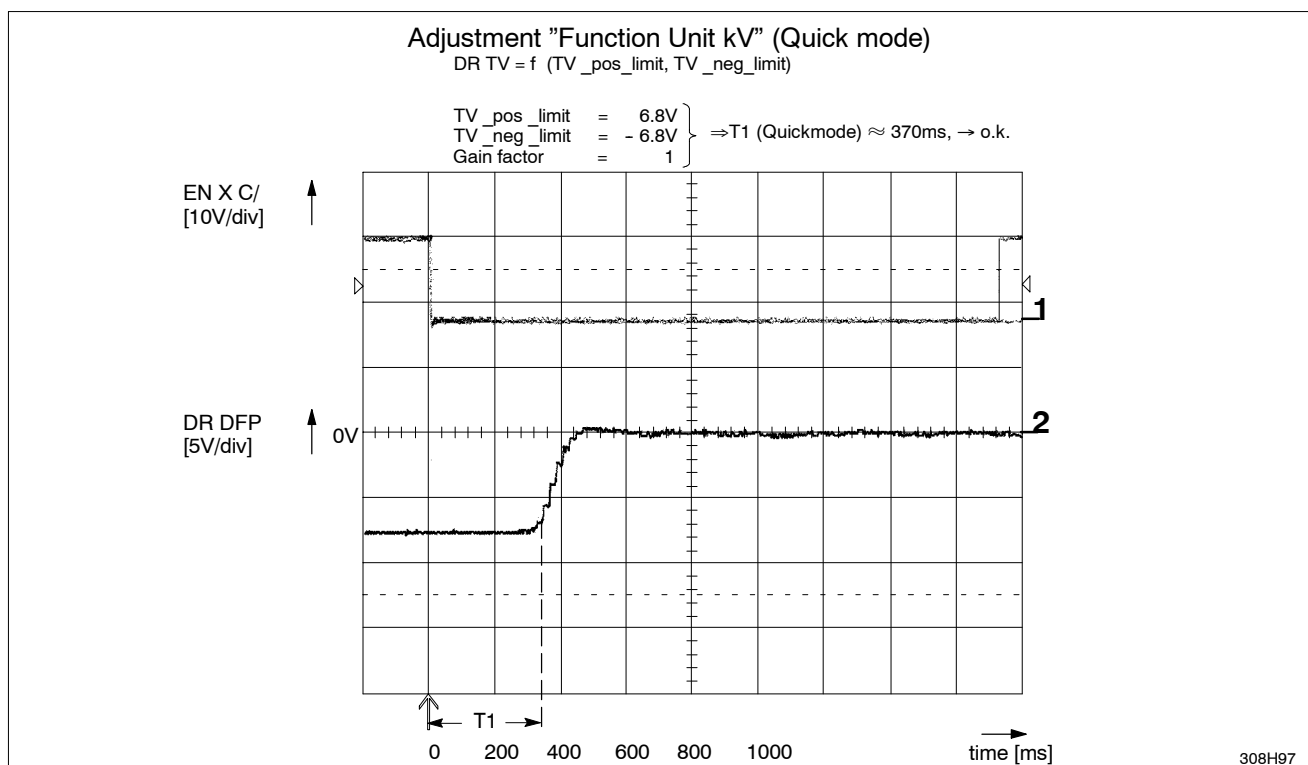
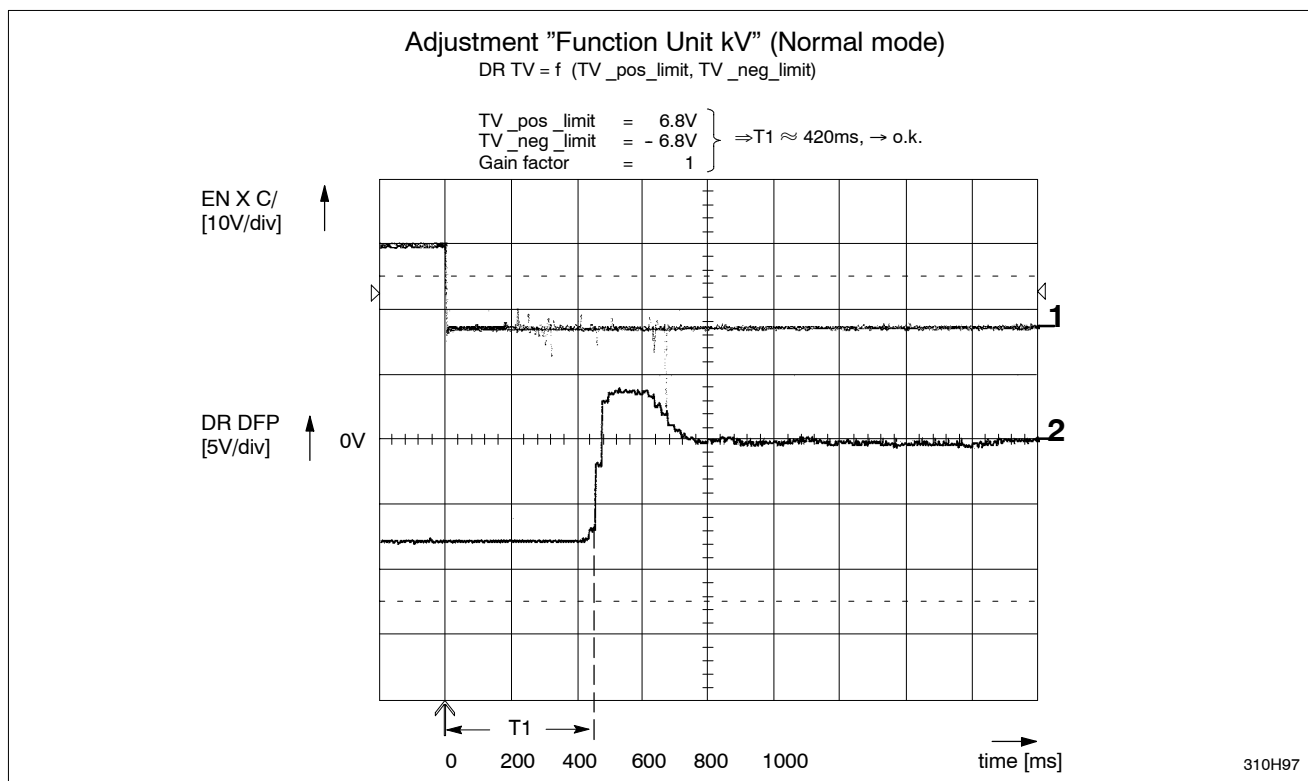
- TV_pos_limit [V]	: [7.3]	} ==> T1 ≈ 700ms --> too long --> reduce TV_pos_limit [V]
- TV_neg_limit [V]	: [-7.3]	
- Gain factor	: [1.00]	



Second reference oscillogram:

Values adjusted with XRGSCOPE:

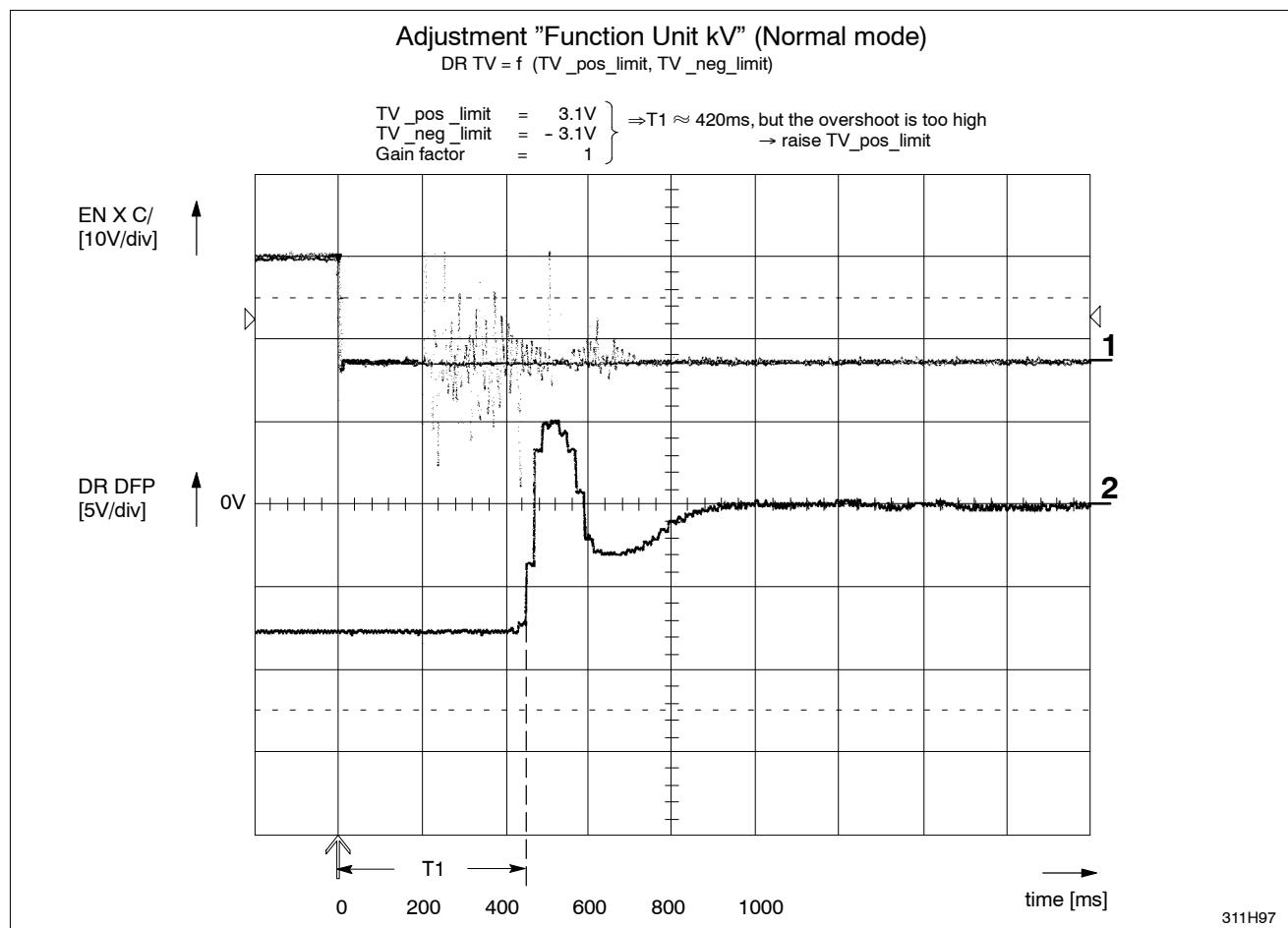
- TV_pos_limit [V]	: [6.8]	} ==> T1 ≈ 420ms --> o.k. and gain factor can remain as they are
- TV_neg_limit [V]	: [-6.8]	
- Gain factor	: [1.00]	



Third reference oscillogram:

Values adjusted with XRGSCOPE:

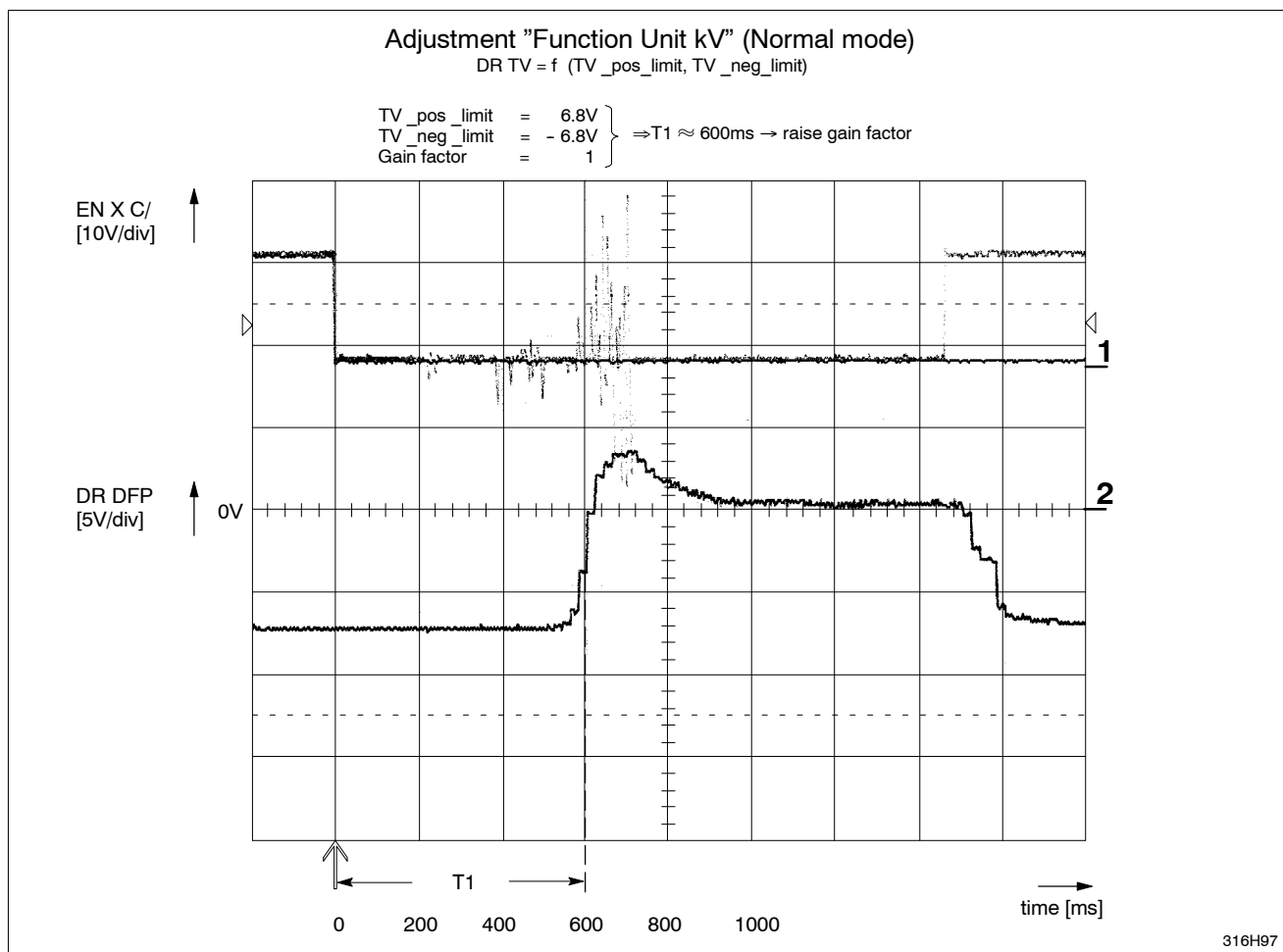
- TV_pos_limit [V] : [3.1]
 - TV_neg_limit [V] : [-3.1]
 - Gain factor : [1.00]
- } ==> T1 ≈ 420ms --> o.k., but the overshoot is too high
 The TV image flashes!
 --> Raise TV_pos_limit [V]



Forth reference oscillogram:

Values adjusted with XRGSCOPE:

- TV_pos_limit [V]	: [6.8]	} ==> T1 ≈ 600ms --> too long --> Raise gain factor to 1.00!
- TV_neg_limit [V]	: [-6.8]	
- Gain factor	: [0.50]	



3. Maximum patient entrance dose rate: Entrance Dose rate Limiter (EDL)

3.1. Aim

In some countries the maximum patient entrance dose rate must be limited to comply with the respective national regulations, for instance 10R/min = 1.4567 μ Gy/s in the USA.

3.2. Principle

The maximum patient entrance dose is measured with maximum kV. By reducing the maximum power **P_max_EDL** provided by the generator, the dose rate is reduced until it complies with the national regulations or the individual wish of the user.

Note

*The dose rate reduction programmed via **P_max_EDL** is effective only when the SID contact (Source Image Distance) is switched ON: WB X12:1 DRLM \rightarrow closed!*

3.3. Alignment

- Cover the I.I. with lead such that with fluoroscopy maximum kV (110kV) are adjusted (protection of the I.I. against excessive radiation).
- Adjust the exam./aux. unit in such a way that the SID contact is closed.
If necessary, place a shorting plug on decade: WB X12:1 <----> X12:10 (ground).
- Adjust the exam./aux. unit in such a way that the smallest distance between tube and patient is effective.
- Position the dose rate measuring chamber in such a way that it is at the same height where the radiation would enter the patient.
- Switch ON fluoroscopy.
- Reduce/raise **P_max_EDL [W]** with the service software XRGSCOPE until the dose rate is identical with the maximum permissible value:

XRGSCOPE OPTIMUS

--> Program

--> Dose rate control

--> **CONT:**

```
+ ----- CONT_MOD.TDL ----- +
| scantime_TV [ms]:    [ 20.000] |
| scantime_TV valid:      Yes    |
|
| P_max_EDL [W]:      [  nnn]   |
|
| TV_pos_limit [V]:     [ 6.8]   |
|
| TV_neg_limit [V]:     [-6.8]   |
| -----
|    < OK >
| -----
```

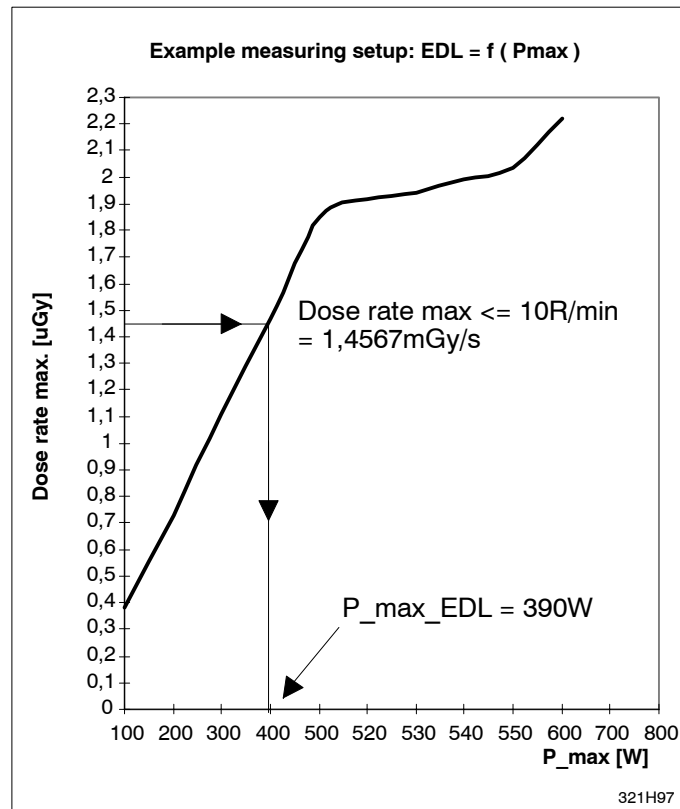
Range: 0 ... 9000W (250 default)

\rightarrow Effective only when SID contact WB X12:1 DRLM is switched ON.

- Note the measuring values:

P_max_EDL: [W]														
Dose rate: [μGy/s]														

Example of a measuring setup:



ACCEPTANCE

	Contents	7-0.1
1.	Preface	7-1
2.	Test equipment	7-1
3.	Setup	7-1
4.	Test	7-2
5.	Exposure counter	7-3

1. Preface

The national rules for accepting an X-ray system are very different. Therefore in the following an example is given for checking the generator in the USA.

OPTIMUS generators are factory-calibrated and checked for compliance with the parameter readout tolerances as stated in the relevant Operator's Manuals.

Provided that these generators are installed and set to work in accordance with the Installation Manuals, only the following limited field compliance testing is required.

2. Test equipment

- Keithley voltage divider model No. 35080 with filter packs 32867C, 5C, 9C or equivalent
- Oscilloscope (storage)
- Digital mA, mAs meter

Note

Do not start test until generator has been switched ON for at least one hour.

Direct (invasive) kVp measurements on OPTIMUS generators with HV divider tanks normally available to the field service organization are not permitted.

Measurements of kV using instruments other than the Keithley instrument may lead to larger measuring tolerances. The causes are to be found in the specific frequency response and transient response of each test instrument.

3. Setup

- Switch OFF generator and also switch OFF mains.
Disconnect breaker to system.
- Connect digital mA meter as per instructions in the relevant Service Manual.
- Set up the Keithley voltage divider complete with the appropriate filter as per Keithley Instructions Manual No. 3294 OIM.
- Connect the oscilloscope to the Keithley divider.

Note

Make sure that the oscilloscope has been calibrated with the aid of the Keithley divider as described in the Keithley Instructions Manual before starting any testing (par. 3.6. Internal Calibration).

- Calculate rejection limits based on the exposure parameter "Specification Limits" shown in the table below.
The "Specification Limits" are based on the actual tolerances as listed in the generator Operator's Manuals. These "Specification Limits" must be restricted to include the actual measuring instrument error.
See also section 6, chapter 3.2 of the "COMPREHENSIVE COMPLIANCE TESTING MANUAL", No. 4535 800 2034x. regarding how to calculate rejection limits.

4. Test

- Switch the system ON.
- Measure the mains voltage on ENF1.

Reference voltage: Mains voltage programmed $\pm 10\%$

Actual values: L1 – L2: V

L1 – L3: V

L2 – L3: V

- Select the largest focus.
- Release exposures according to the table below and compare the values measured with the reference values.

Technique	Parameter	Reference range	Measured value	Corrected value
3-knob technique	81kV $\pm 5\%$ ± 1 kV	76 ... 86kV	..... kV	—
	250mA $\pm 5\%$ ± 0.5 mA	237 ... 263mA	..... mA	..... mA
	100ms $\pm 5\%$ ± 0.5 ms	94.5 ... 105.5ms	..... ms	—
2-knob technique	125kV $\pm 5\%$ ± 1 kV	118 ... 132kV	..... kV	—
	80mAs $\pm 3\%$ ± 0.5 mAs	77.1 ... 82.9mAs	..... mAs	..... mAs

Owing to an offset current in the measuring circuit of the HV generator the measured values for mA / mAs must be adjusted using the following formulas:

$$I_{\text{corrected}} [\text{mA}] = I_{\text{measured}} [\text{mA}] - \frac{U [\text{kV}]}{R_{\text{calc}} [\text{M}\Omega]} \quad \text{Offset} \approx 0.2 \dots 0.75 \text{mA}$$

$$Q_{\text{corrected}} [\text{mAs}] = Q_{\text{measured}} [\text{mAs}] - \frac{U [\text{kV}] \times t [\text{s}]}{R_{\text{calc}} [\text{M}\Omega]} - \frac{4.55 [\text{nF}] \times U [\text{kV}]}{1000}$$

Cable charge for 20m HV cable

R_{calc} = calculated measuring circuit resistance.

Typical value: $\approx 200 \text{M}\Omega$

Read out R_{calc} via service menu: FU_MA/ FAULT FIND/ **READ I_e CORRECTIONS**

Focus assignment: Focus 1 = tube 1 large focus
2 = tube 1 small focus

t = exposure time according to Cockpit display

5. Exposure counter

Before handing over the generator to the customer, read the exposure counter.

Use menu:

ACCEPT/ INSPECT/ TUBE STATISTIC/ TUBE 1 ... 3 STATISTIC/ **SHOW TUBE STATISTIC**

Record the figure in the table below.

Tube load statistic variable	Unit	Tube
Reset date	dd.mm.yy	
Last update	dd.mm.yy	
Preparation time large focus	s	
Preparation time small focus	s	
Preparation time vario focus	s	
Preparation counter large focus	1	
Preparation counter small focus	1	
Preparation counter vario focus	1	
Fluoro time	min	
Fluoro counter	1	
Exposure counter large focus	1	
Exposure counter small focus	1	
Exposure counter vario focus	1	
Overload exposures counter large focus	1	
Overload exposures counter small focus	1	
Overload exposures counter vario focus	1	

The table should be reset whenever the tube is being replaced.

Use menu:

ACCEPT/ INSPECT/ TUBE STATISTIC/ TUBE 1 ... 3 STATISTIC/ **RESET TUBE STATISTIC**

Record the figure in the table above.

Explanation:**Reset date / Last update:**

Reset date and date of last update of the tube statistic.

Preparation time:

The sum of all preparation times per focus.

Preparation counter:

Counts the occurrences of transition STANDBY or FLUORO to PREPARATION per focus.

Fluoro time:

The sum of all fluoro times.

Fluoro counter:

Counts the fluoro commands.

Exposure counter:

Counts the exposures per focus (including the overload exposures).

Overload exposures counter:

Counts the exposures at overload conditions of the tube.

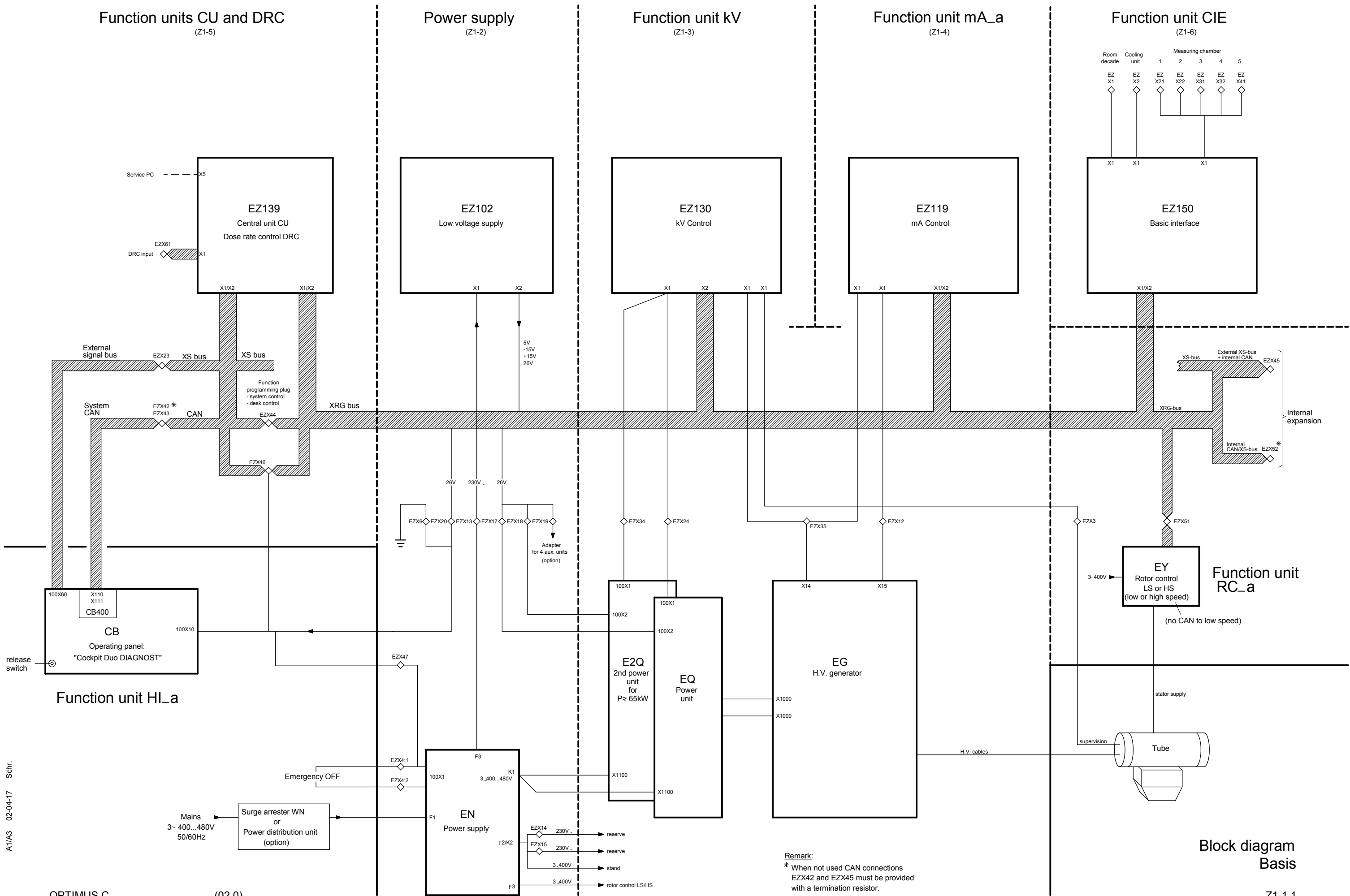
Schematic drawings

Basis

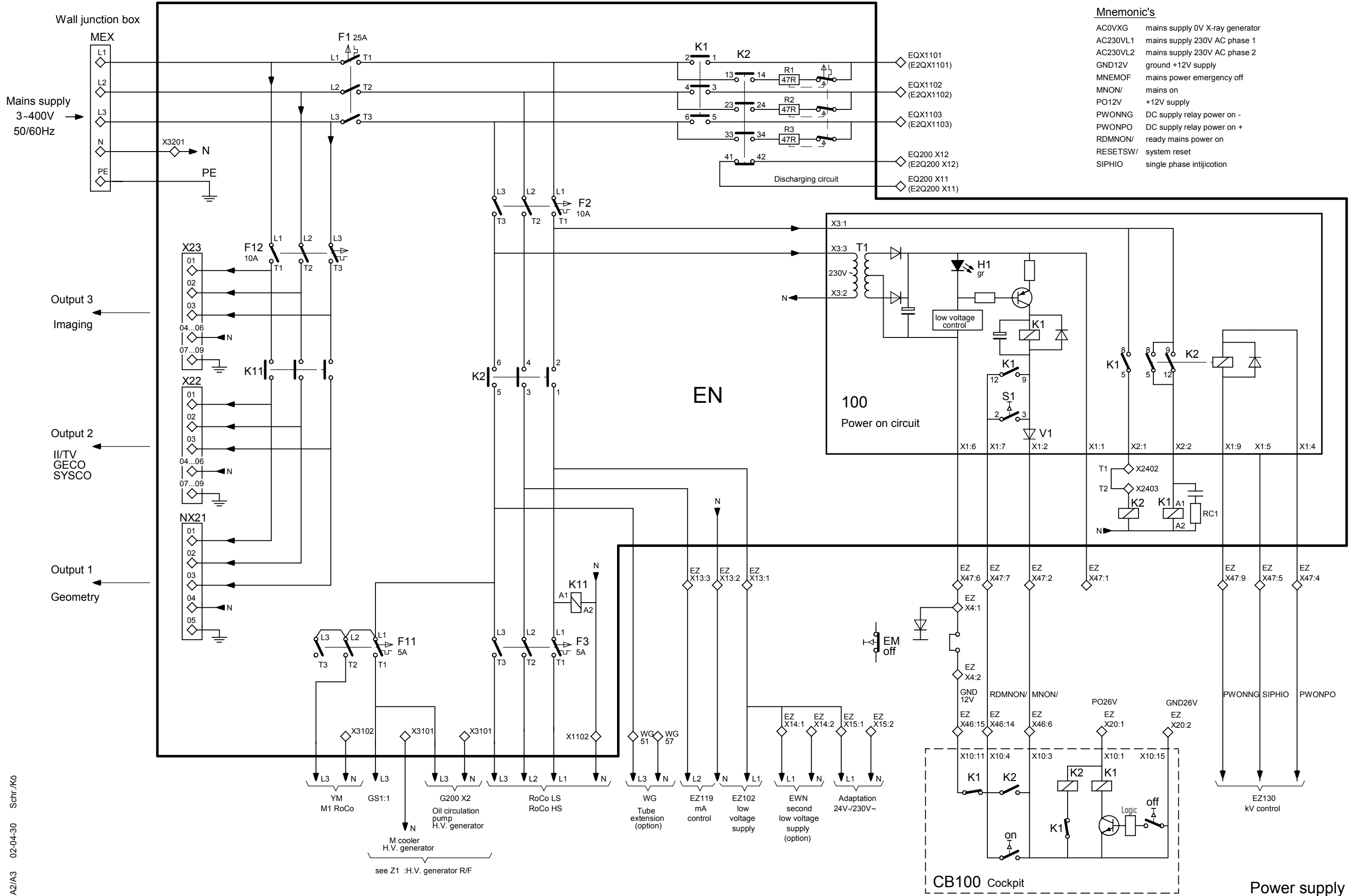
Block diagram basis	Z1-1.1
Power supply	Z1-2.1
Power supply with mains transformer (WT)	Z1-2.2
Low voltage power supply	Z1-2.3
kV control	Z1-3.3
mA control	Z1-4.1
H.V. generator	Z1-4.2
Central unit	Z1-5.1
Basic interface	Z1-6

Options

Dual speed rotor control	
9890 000 0268x	Z1-13.2



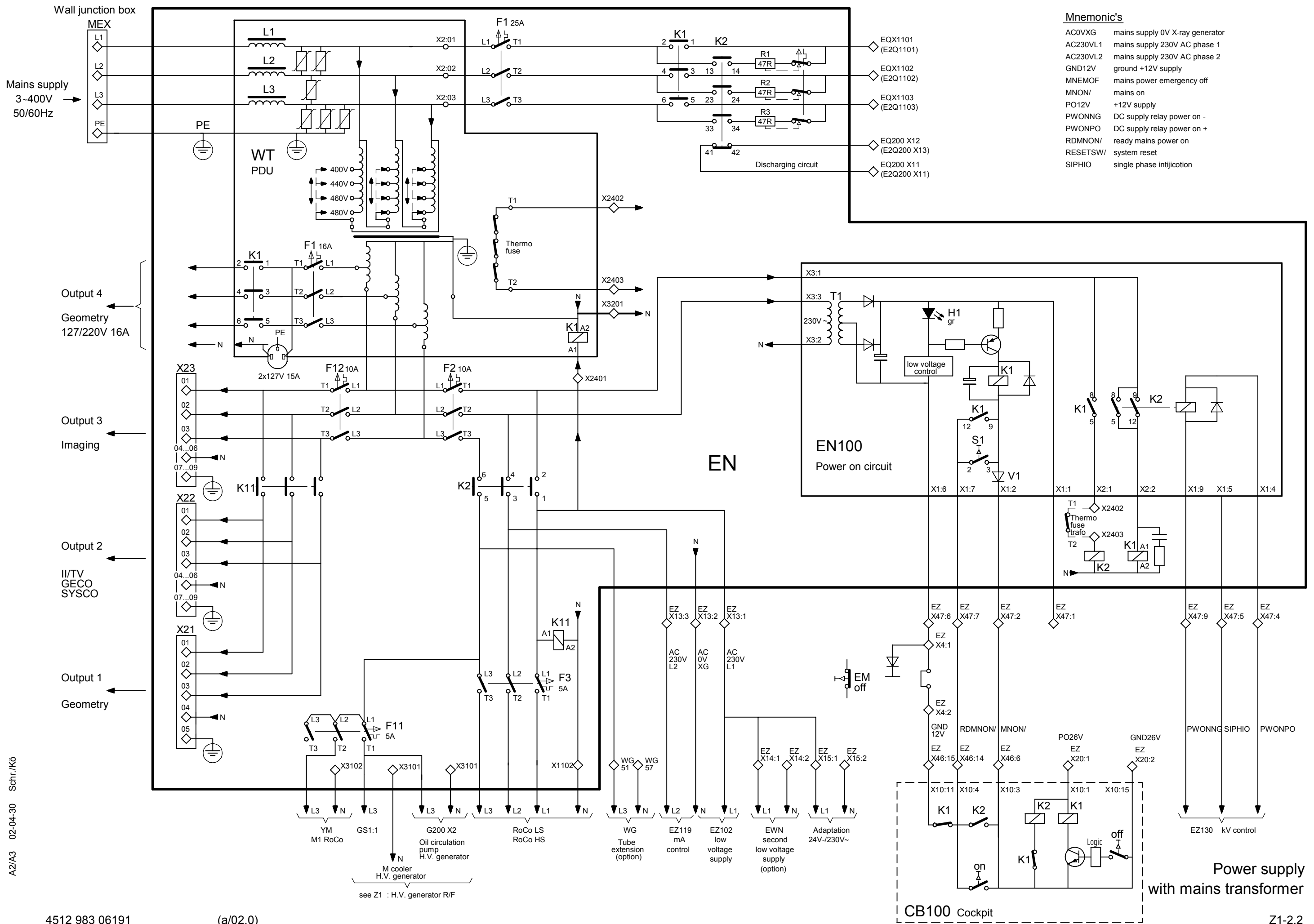
A1/A3 02-04-17 Schr.



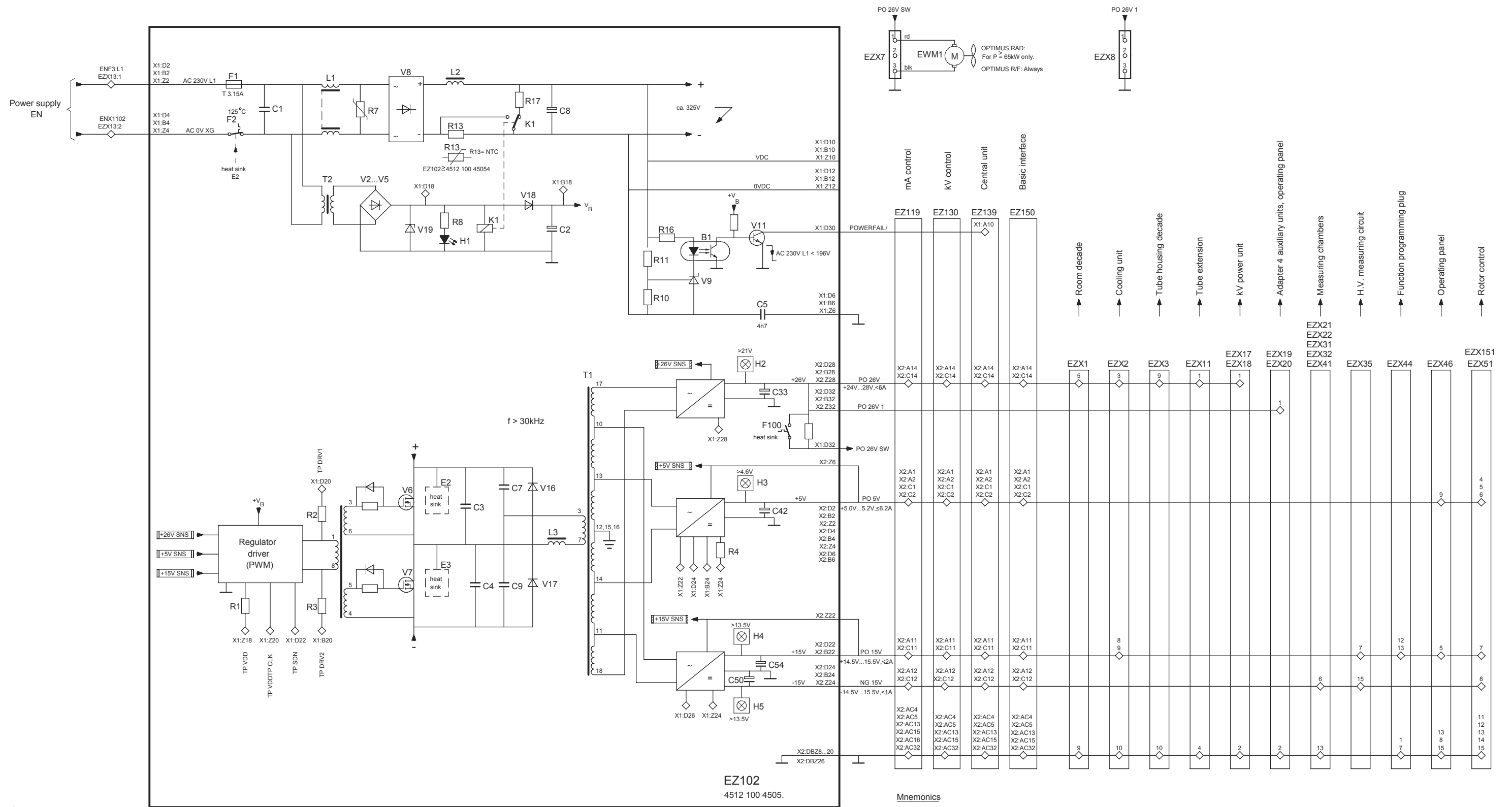
Mnemonic's

AC0VXG	mains supply 0V X-ray generator
AC230VL1	mains supply 230V AC phase 1
AC230VL2	mains supply 230V AC phase 2
GND12V	ground +12V supply
MNEMOF	mains power emergency off
MNON/	mains on
PO12V	+12V supply
PWONNG	DC supply relay power on -
PWONPO	DC supply relay power on +
RDMNON/	ready mains power on
RESETSW/	system reset
SIPHIO	single phase intijcotion

A2/A3 02-04-30 Schr./K6



A2/A3 02-04-30 Schr./Kö



Attention!

The voltage supplies are short circuit proof.
In case of an error refer to selection "Faultfinding".

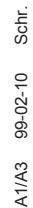
Mnemonics

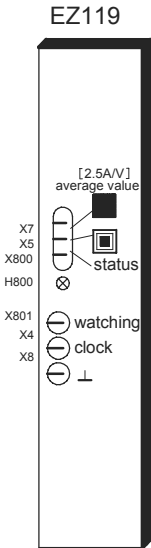
0V DC	
+5V SNS	5V sense
+15V SNS	15V sense
+26V SNS	26V sense
AC 0V XG	mains supply 0V X-ray generator
AC 230V L1	mains supply 230V AC phase 1
NG 15V	-15V supply
PO 5V	+5V supply
PO 15V	+15V supply
PO 26V	+26V supply
PO 26V1	+26V supply optional
PO 26V SW	+26V supply switched
POWERAI L/	power failure reset

TP CLK
TP DRV1
TP DRV2
TP SDN
TP VDD
VDC

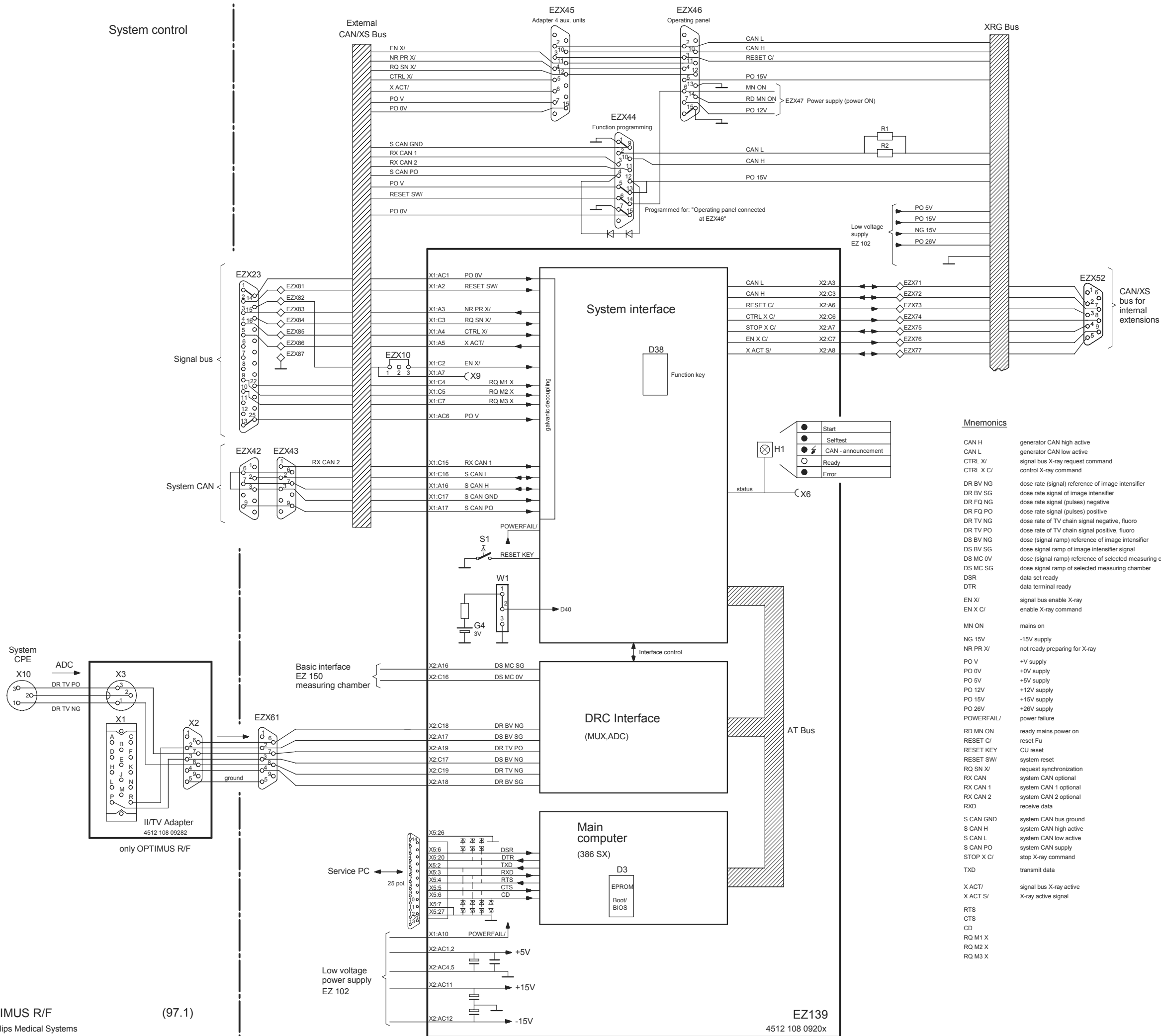
} test points for internal signals

Low voltage power supply



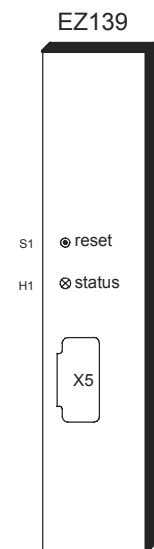


Z1-4.1

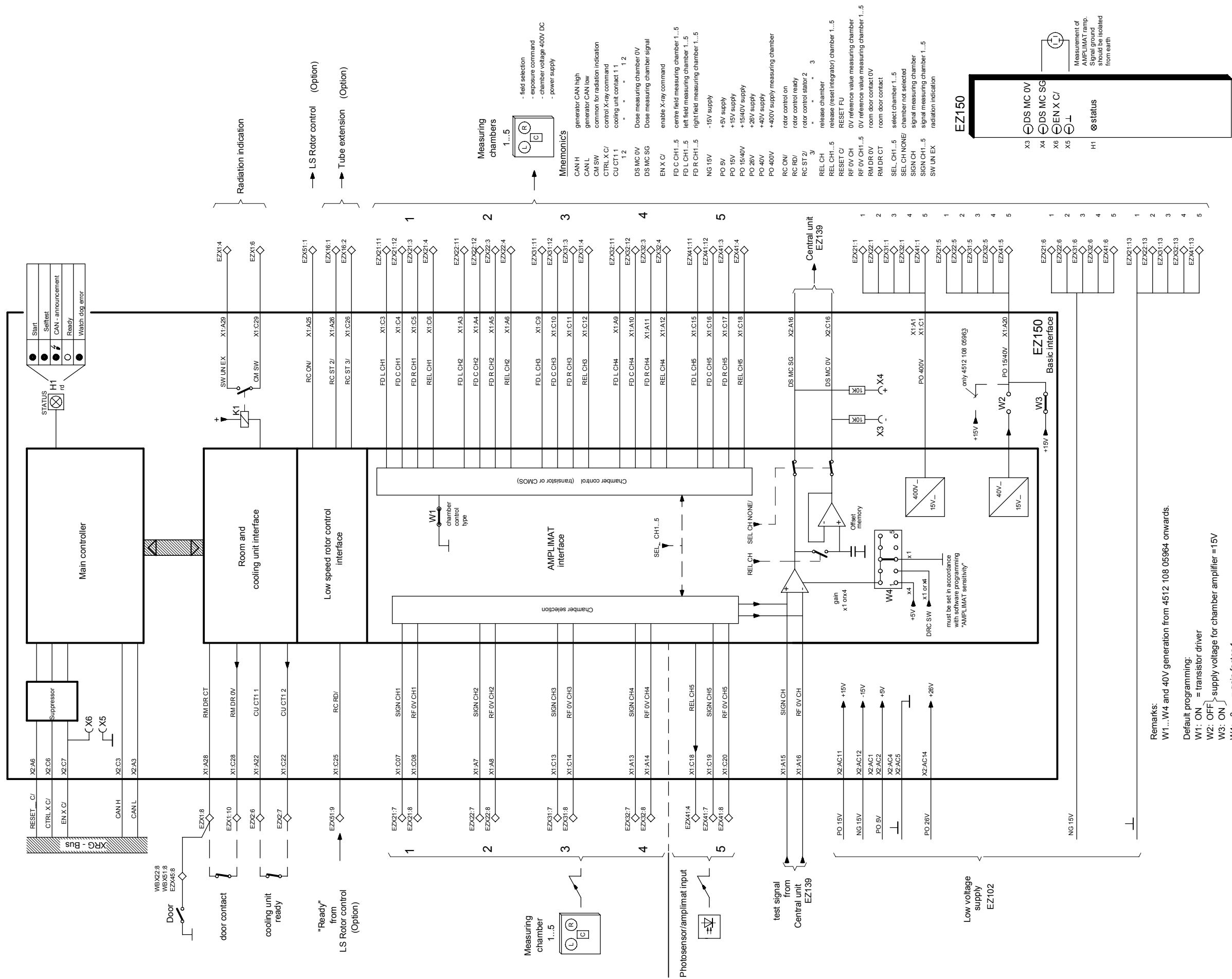


Mnemonics

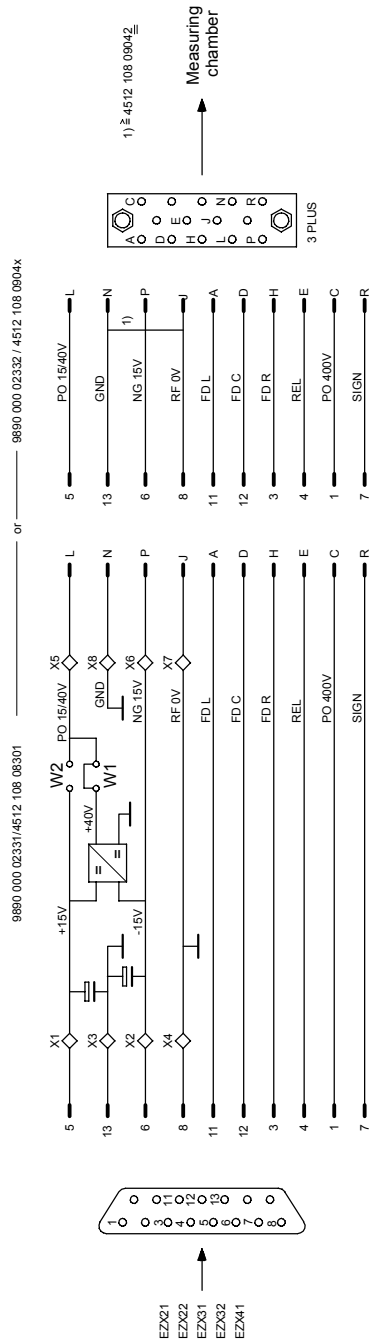
CAN H	generator CAN high active
CAN L	generator CAN low active
CTRL X/	signal bus X-ray request command
CTRL X C/	control X-ray command
DR BV NG	dose rate (signal) reference of image intensifier
DR BV SG	dose rate signal of image intensifier
DR FQ NG	dose rate signal (pulses) negative
DR FQ PO	dose rate signal (pulses) positive
DR TV NG	dose rate of TV chain signal negative, fluoro
DR TV PO	dose rate of TV chain signal positive, fluoro
DS BV NG	dose (signal ramp) reference of image intensifier
DS BV SG	dose signal ramp of image intensifier signal
DS MC 0V	dose (signal ramp) reference of selected measuring chamber
DS MC SG	dose signal ramp of selected measuring chamber
DSR	data set ready
DTR	data terminal ready
EN X/	signal bus enable X-ray
EN X C/	enable X-ray command
MN ON	mains on
NG 15V	-15V supply
NR PR X/	not ready preparing for X-ray
PO V	+V supply
PO 0V	+0V supply
PO 5V	+5V supply
PO 12V	+12V supply
PO 15V	+15V supply
PO 26V	+26V supply
POWERFAIL/	power failure
RD MN ON	ready mains power on
RESET C/	reset Fu
RESET KEY	CU reset
RESET SW/	system reset
RQ SN X/	request synchronization
RX CAN	system CAN optional
RX CAN 1	system CAN 1 optional
RX CAN 2	system CAN 2 optional
RXD	receive data
S CAN GND	system CAN bus ground
S CAN H	system CAN high active
S CAN L	system CAN low active
S CAN PO	system CAN supply
STOP X C/	stop X-ray command
TXD	transmit data
X ACT/	signal bus X-ray active
X ACT S/	X-ray active signal
RTS	
CTS	
CD	
RQ M1 X	
RQ M2 X	
RQ M3 X	



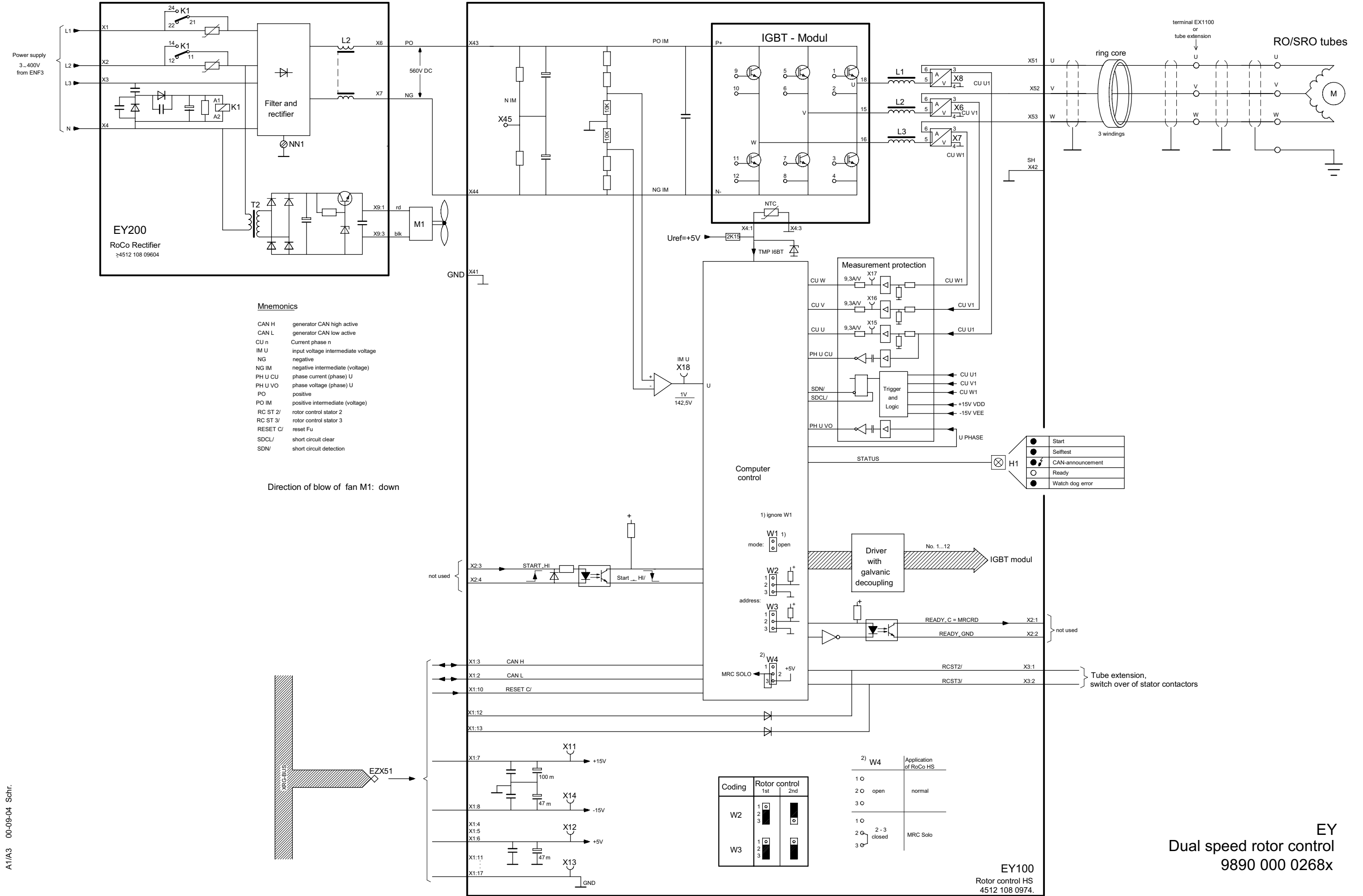
Central unit



Adapter for AMPLIMAT cable (not for OPTIMUS C)



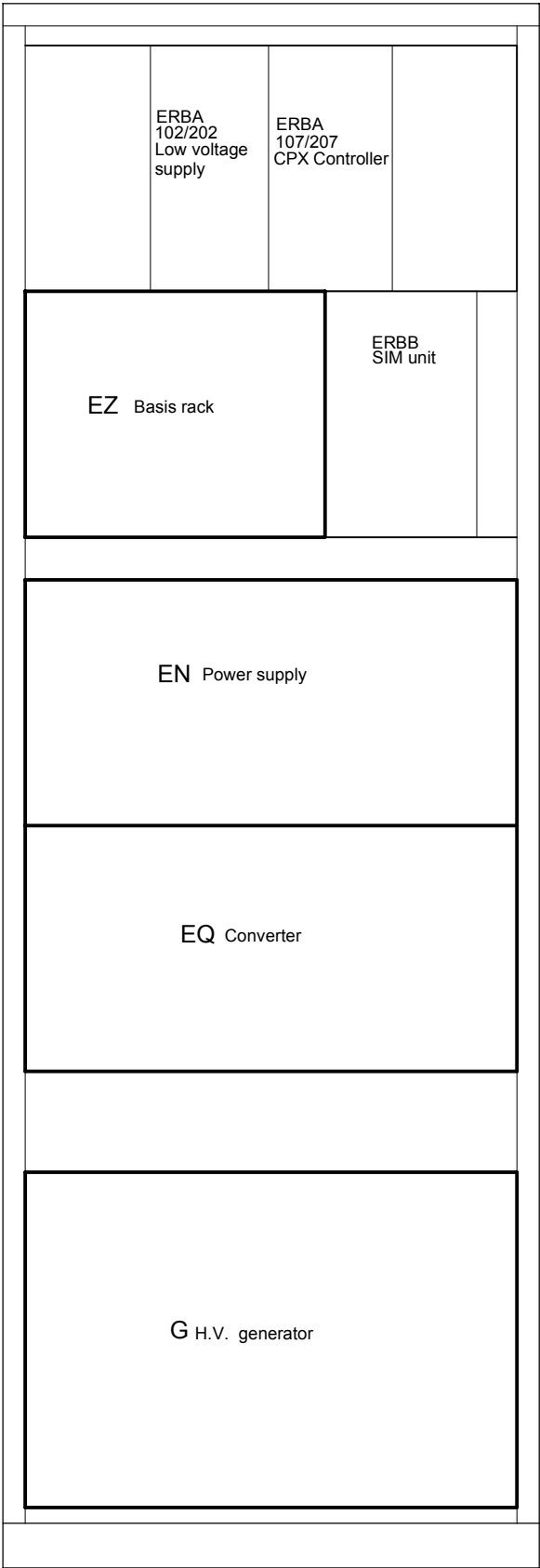
Basic interface



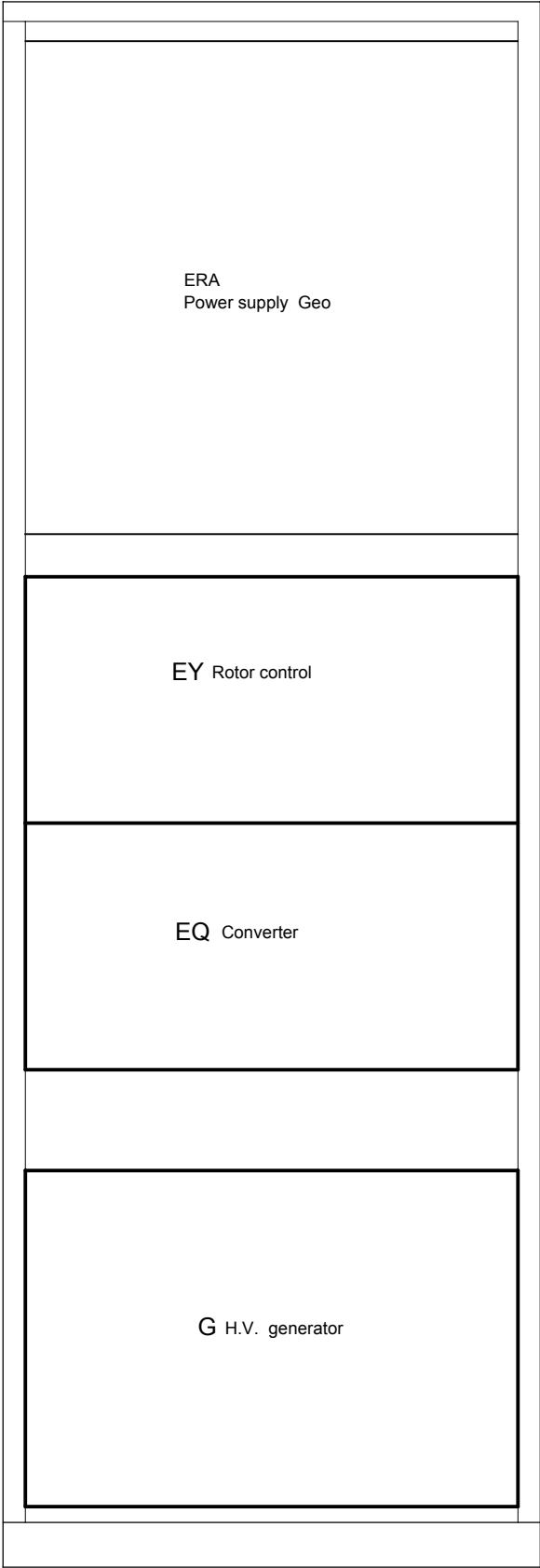
Wiring diagrams

Cabinet E with duo DIAGNOST	Z2-1.0
Cabinet wiring E, 50 kW	Z2-1.1
Cabinet wiring E, 65/80 kW	Z2-1.2
Earthing diagram E	Z2-1.3
Power supply N, 50 kW	Z2-2.1.1/.2
Power supply N, 65/80 kW	Z2-2.2.1/.2
Backpanel EZ / Basis rack-2 Z 4512 108 0936	Z2-5.1/.2/.3
Backpanel EZ / Basis rack-2 Z survey of components	Z2-5.4
Dual speed rotor control 9890 000 0268x	Z2-13
Cabinet wiring: Tube extension WG and air coolers H.V. generator	Z2-14.1
Air coolers H.V. generator	Z2-14.4
Cabinet wiring: Control desk C	Z2-17

front



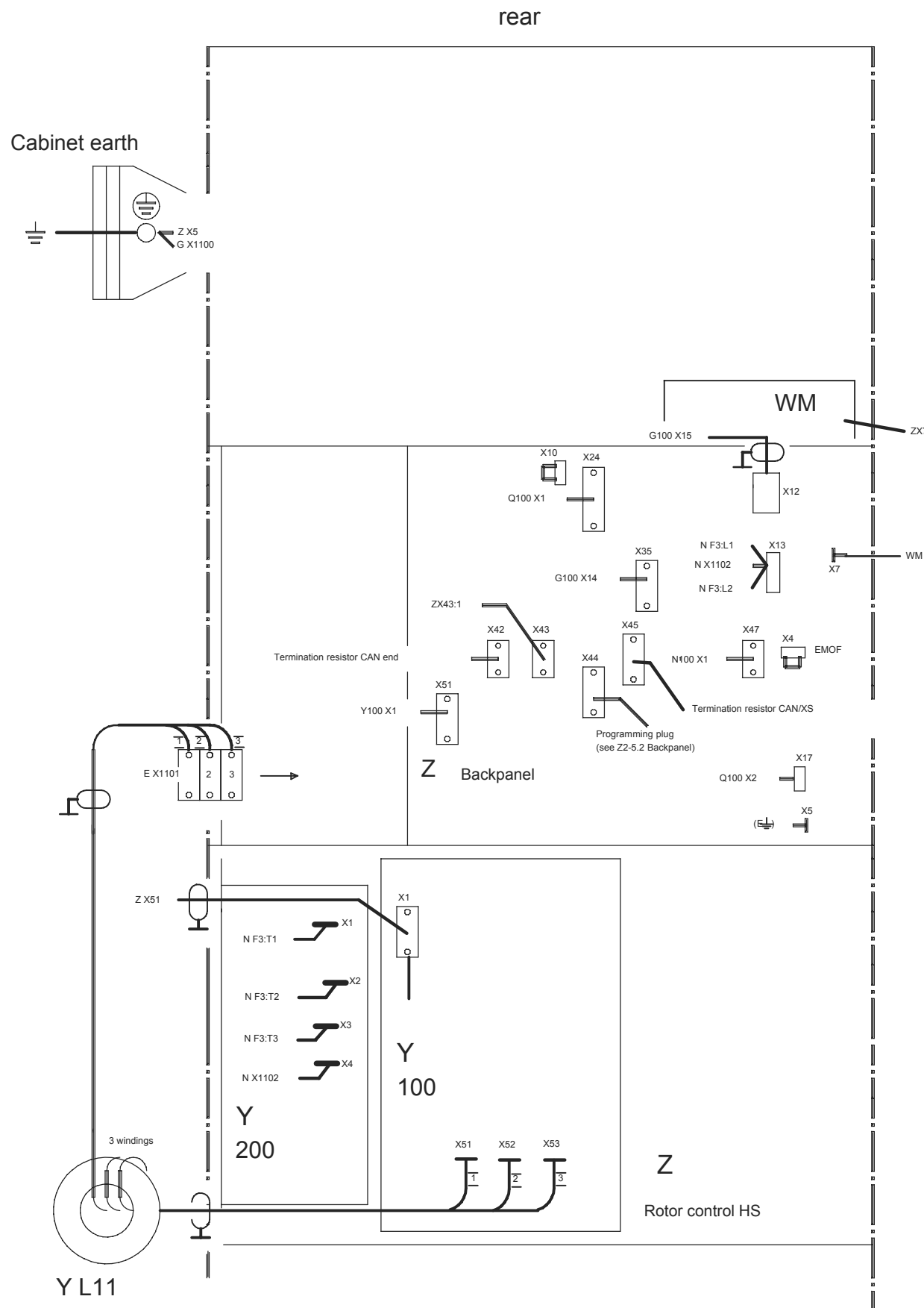
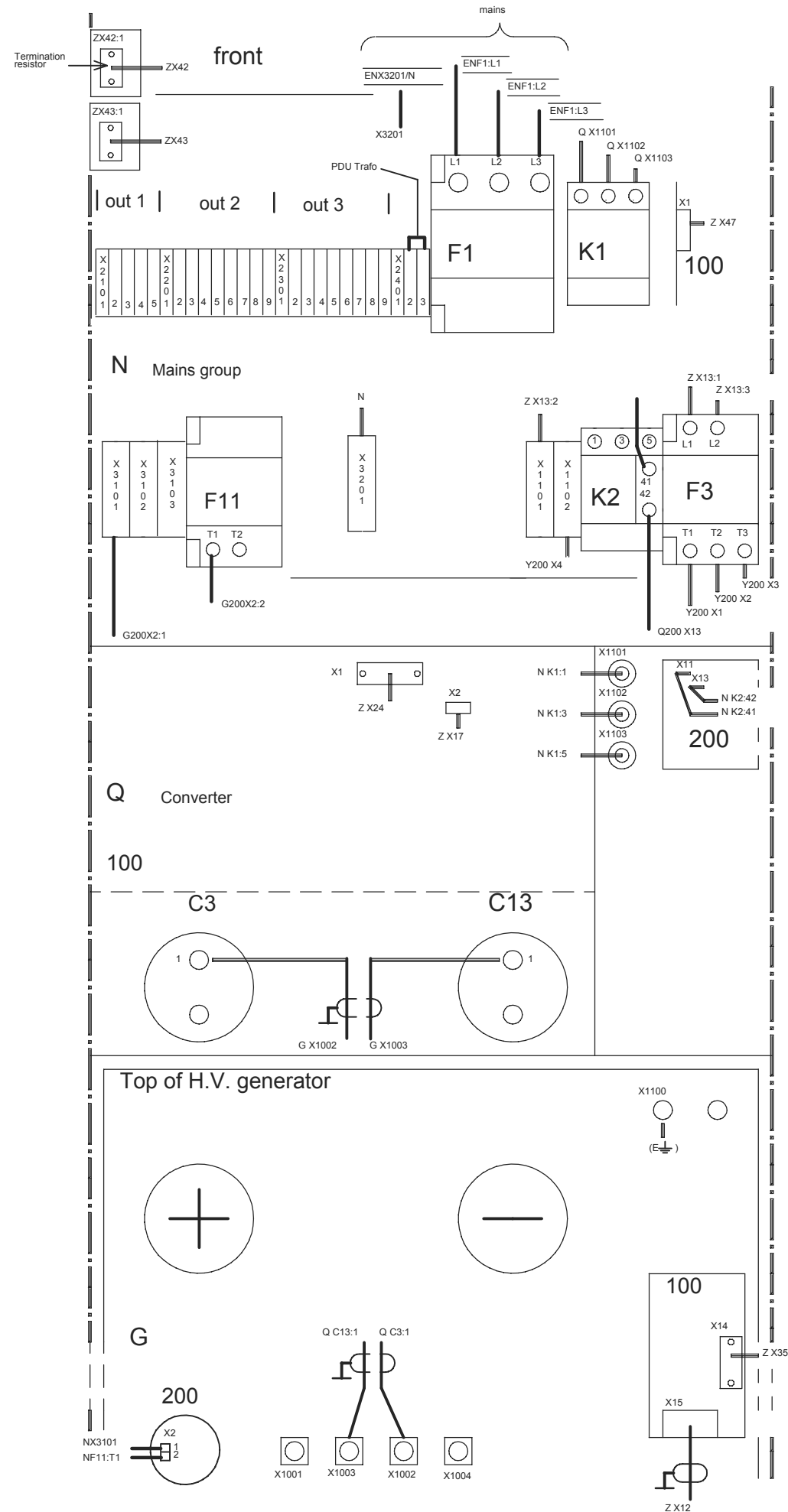
rear

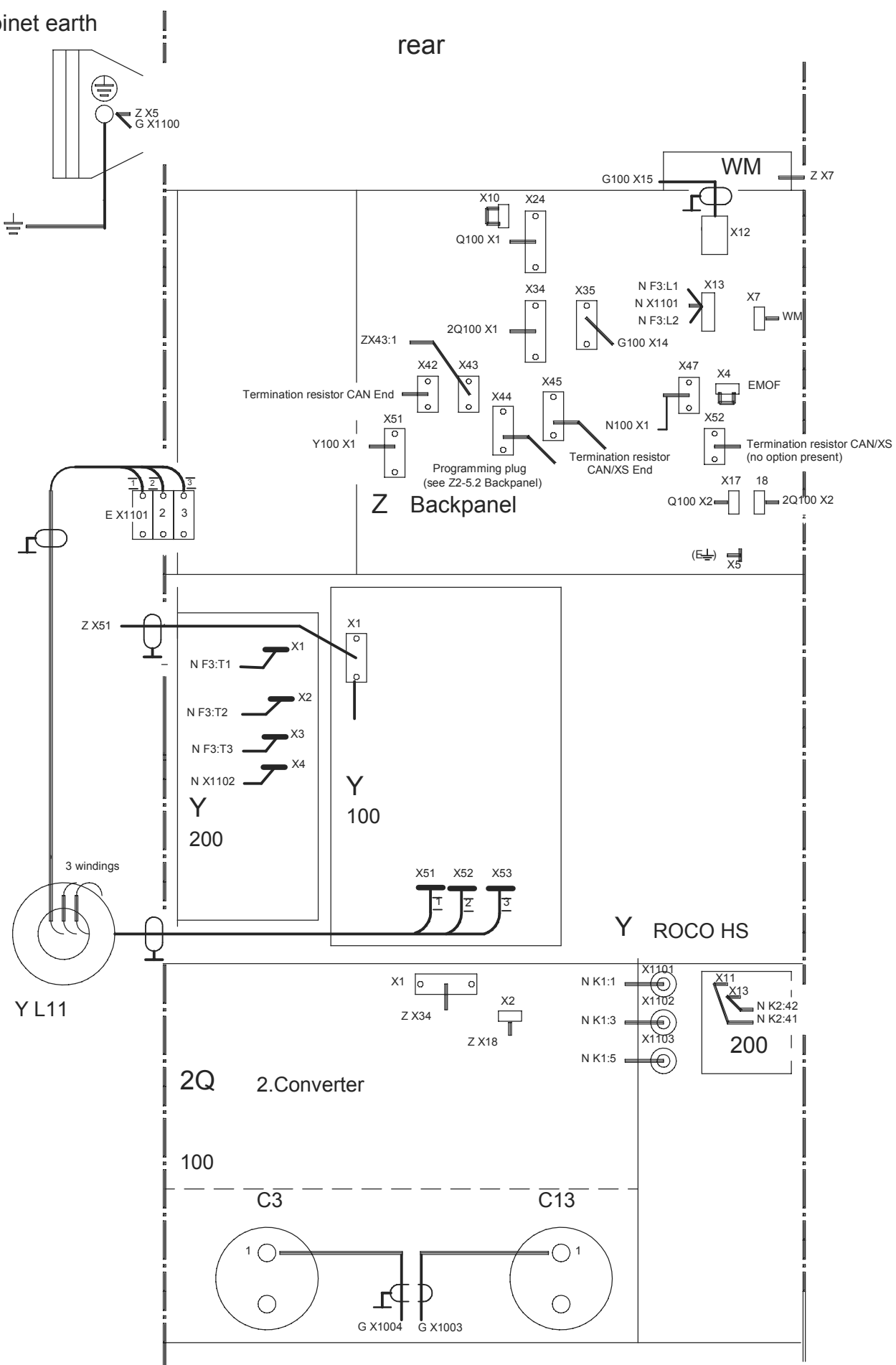
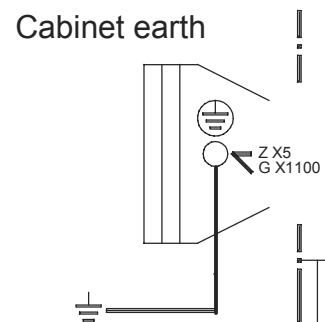
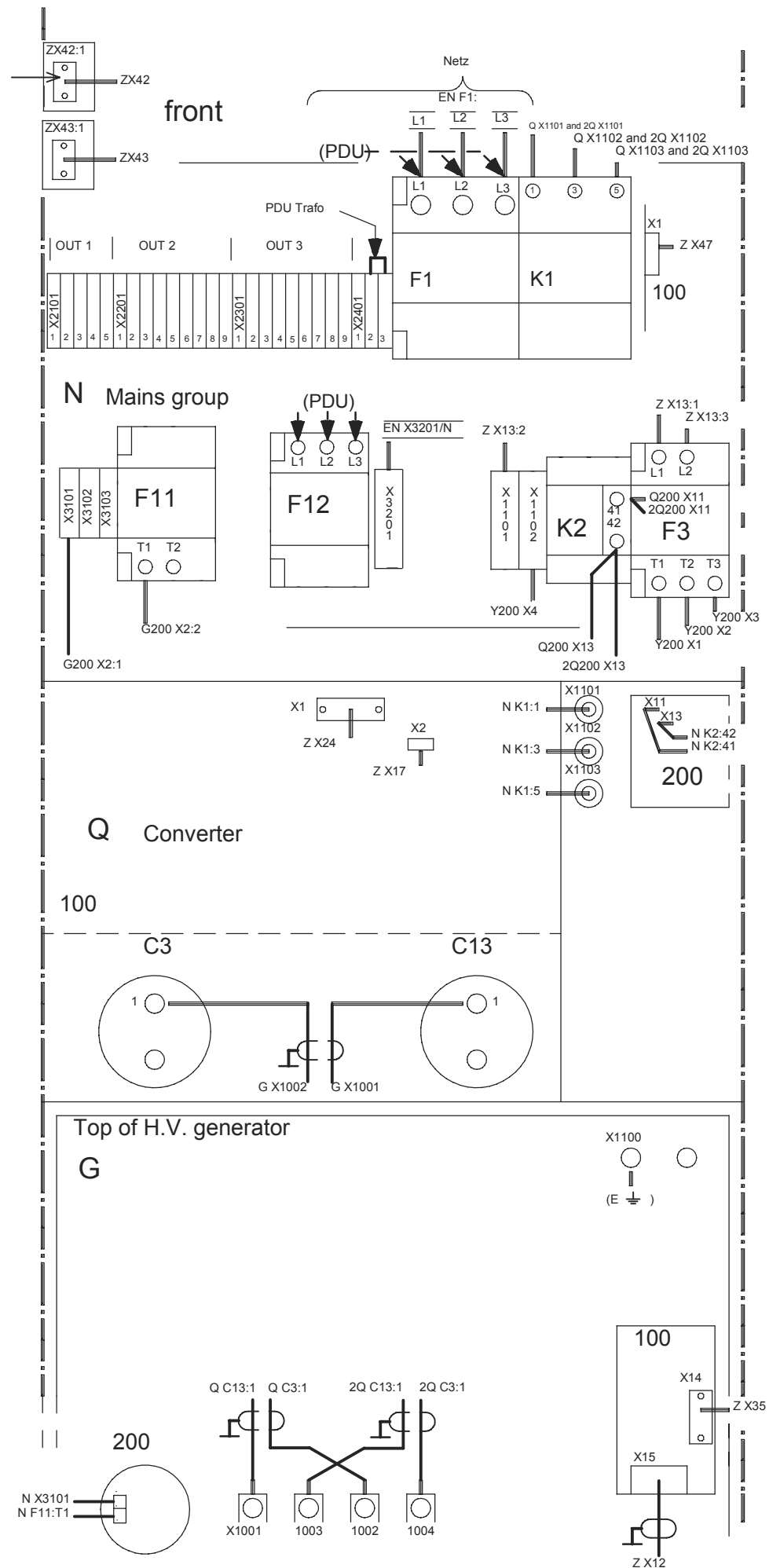


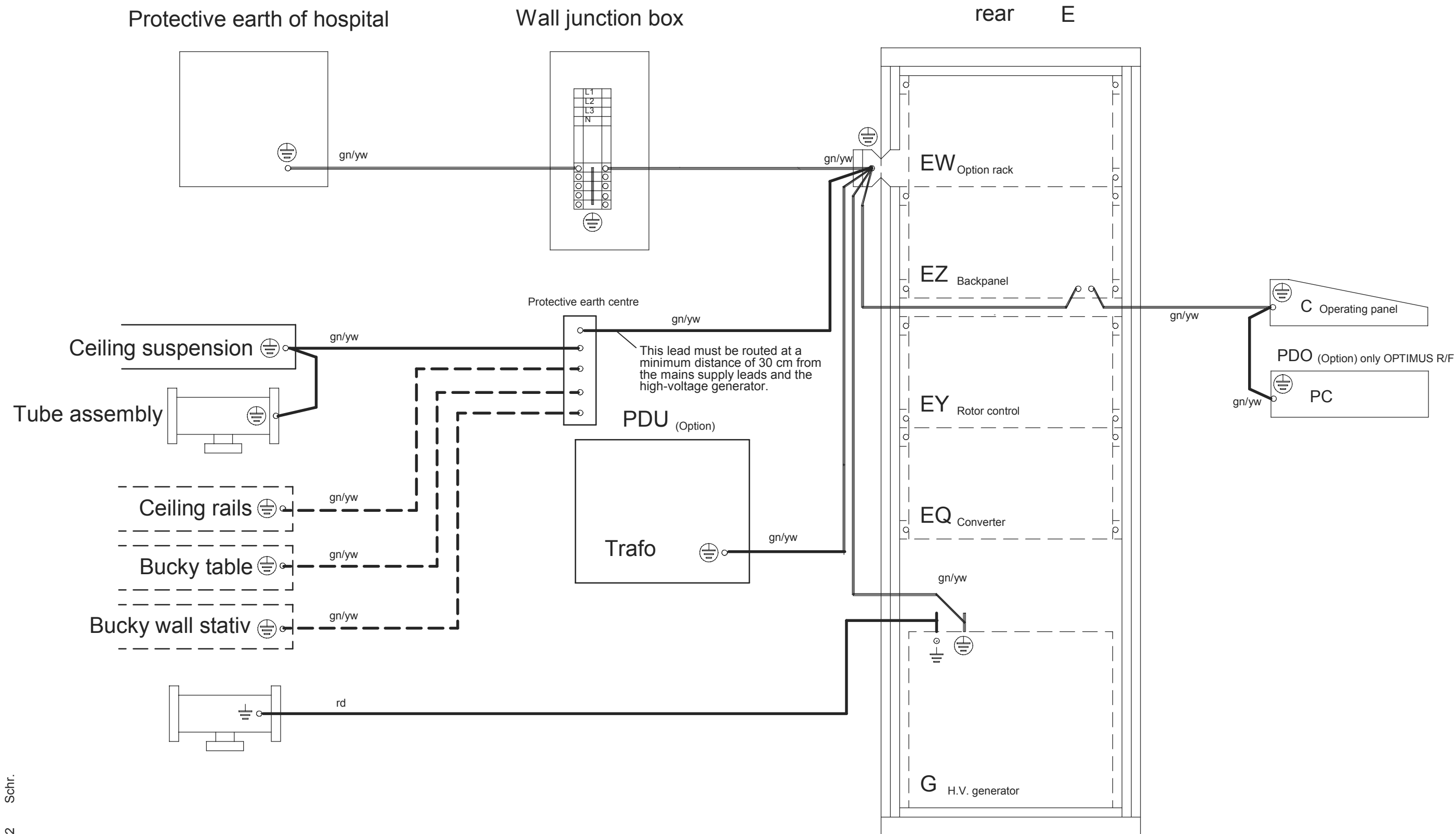
described in
subsystem manual
Central Part duo &
duo DIAGNOST

A3/A4 00-11-14 Schr.

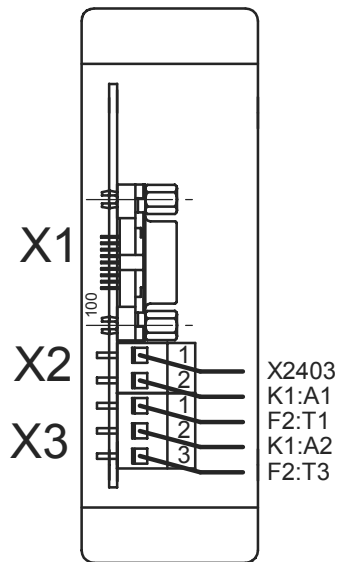
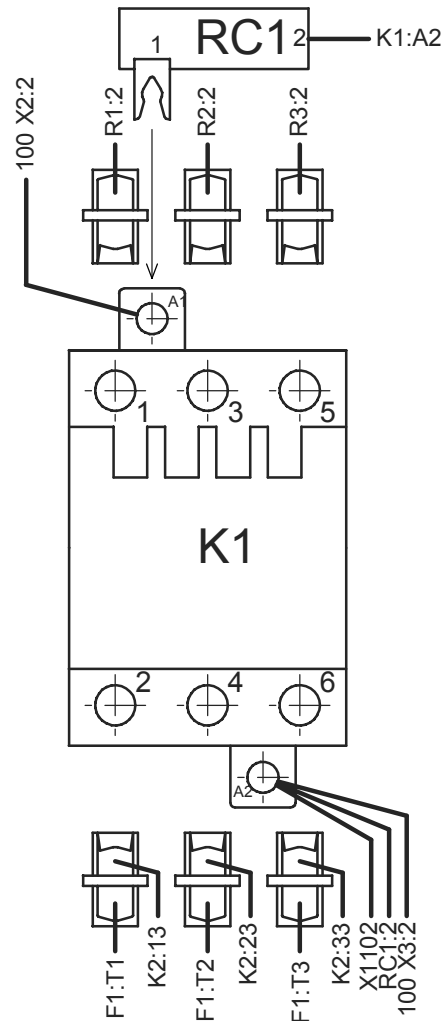
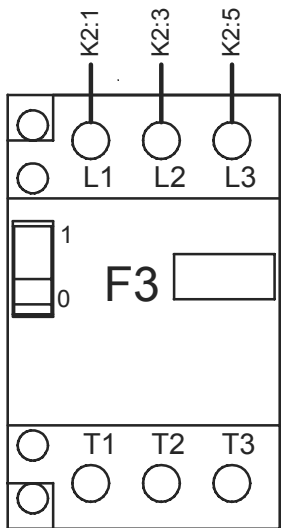
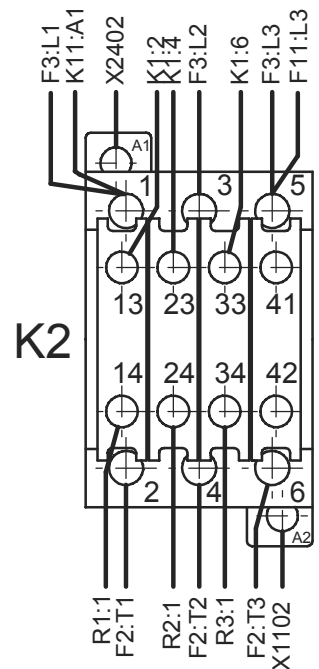
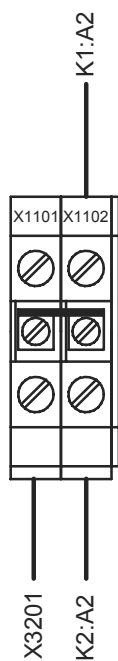
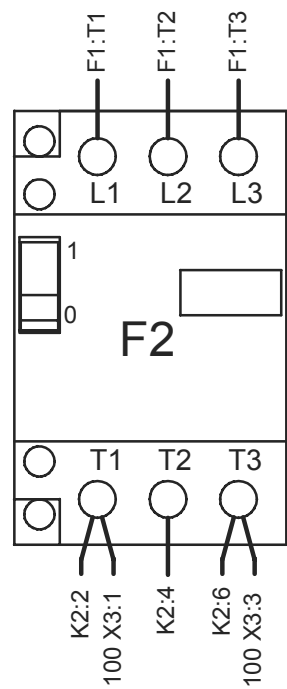
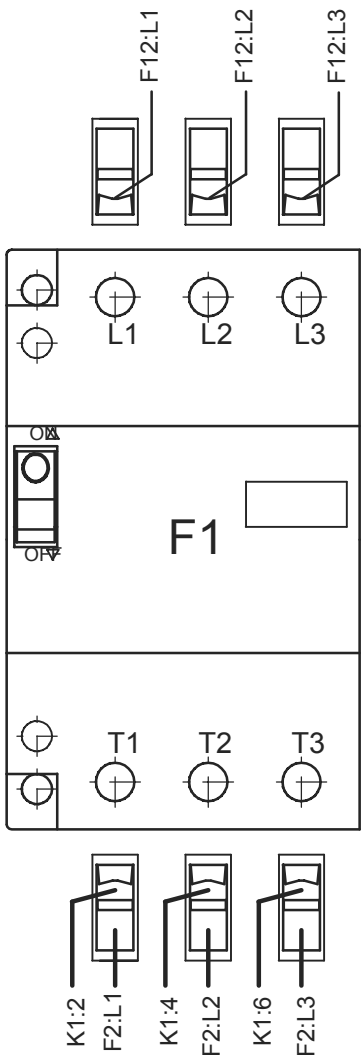
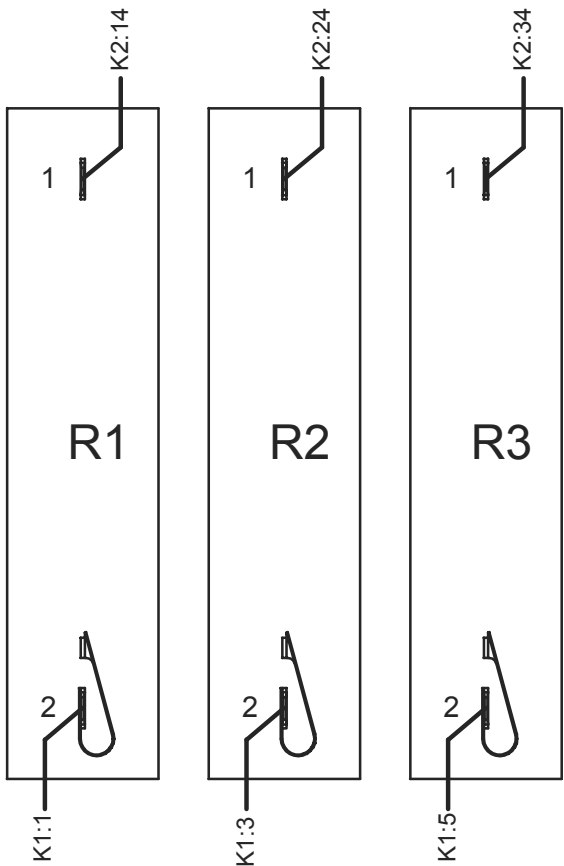
E-Cabinet
with duo DIAGNOST

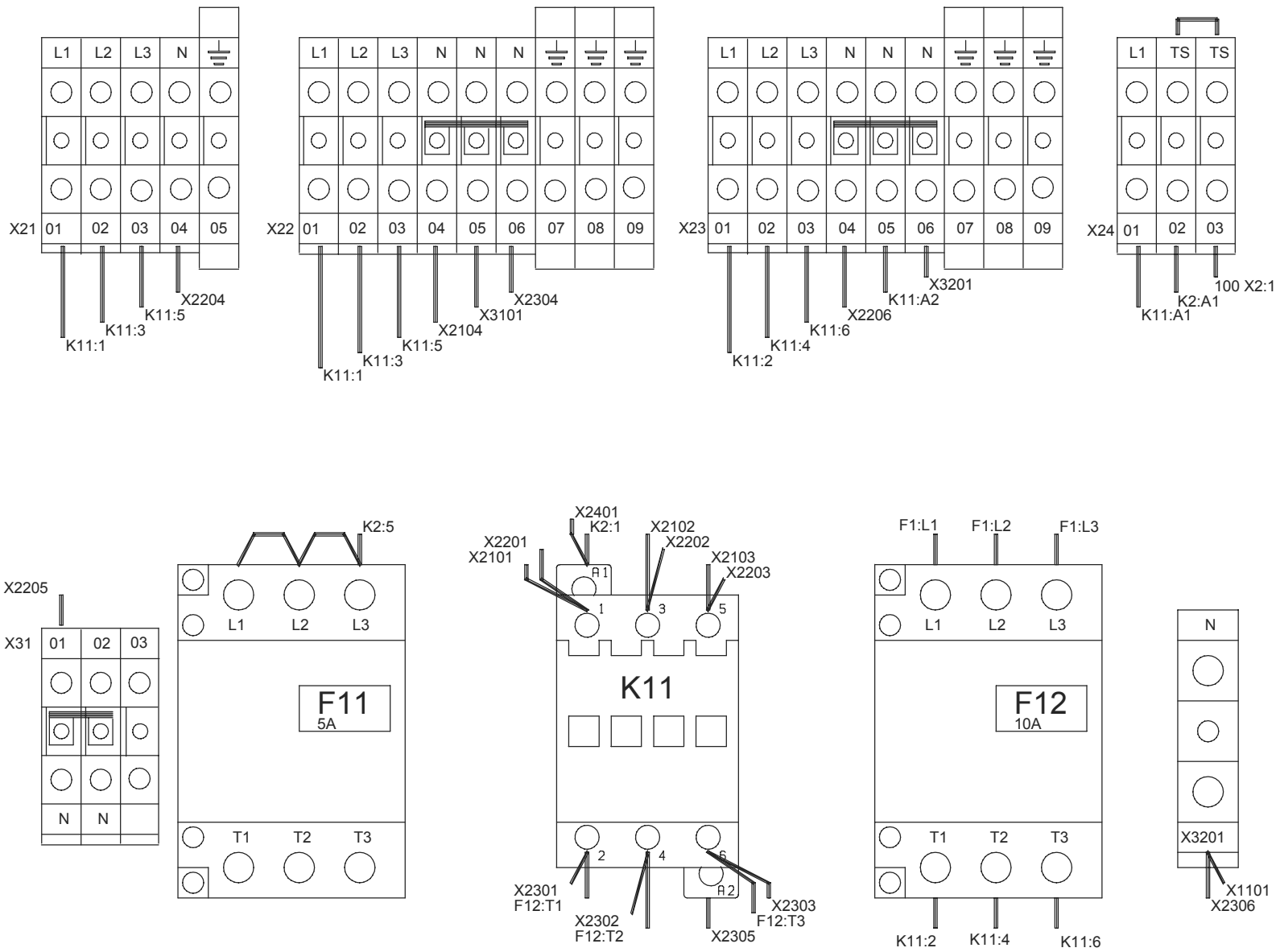


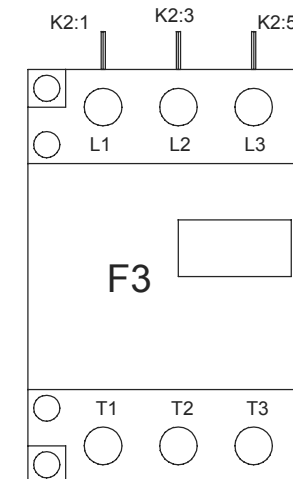
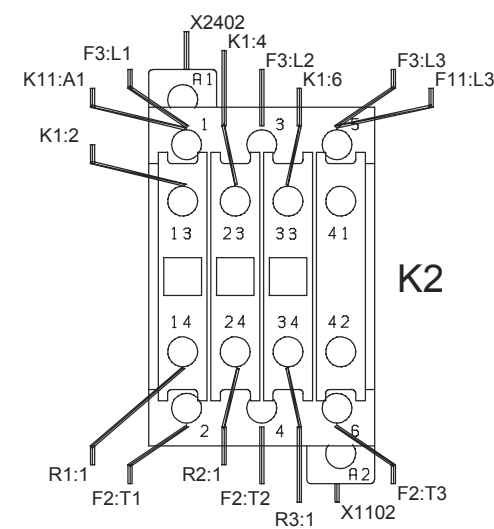
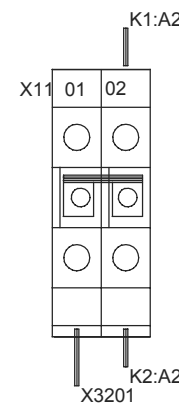
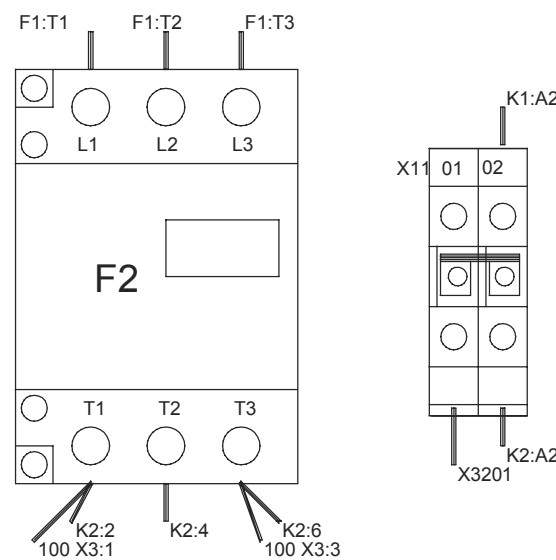
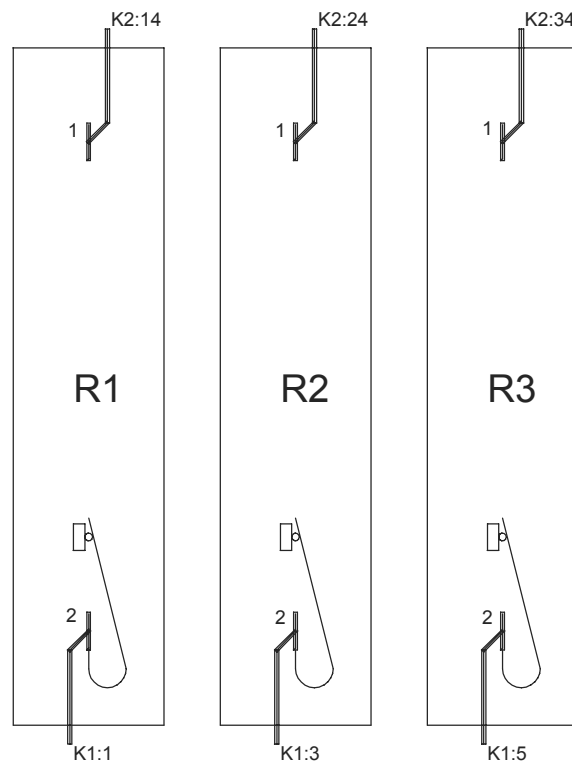
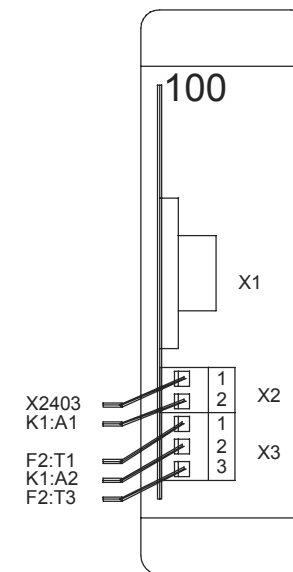
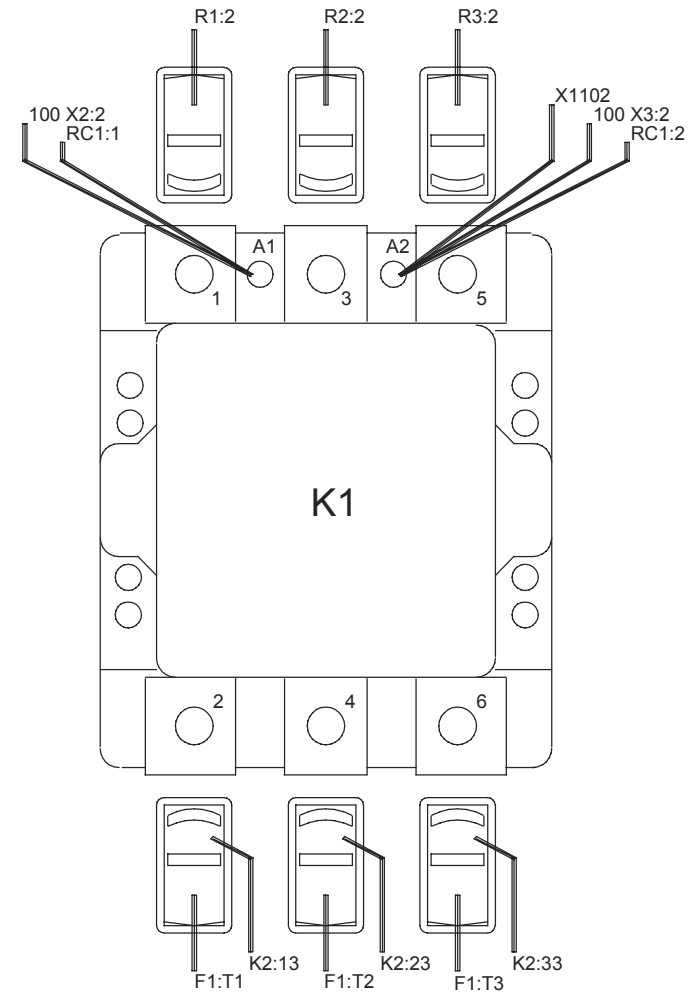
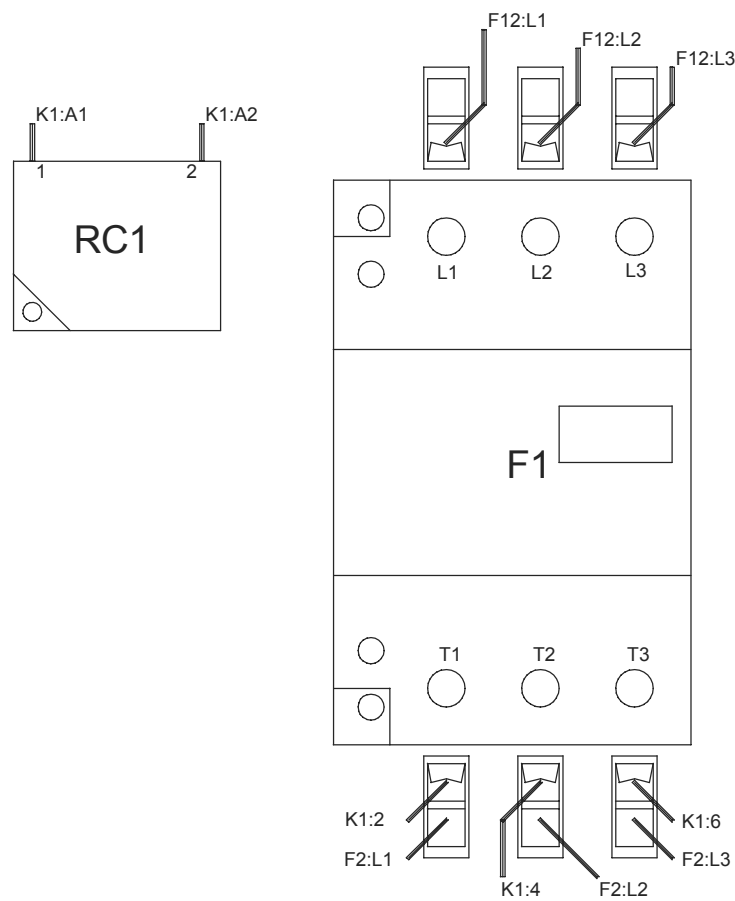


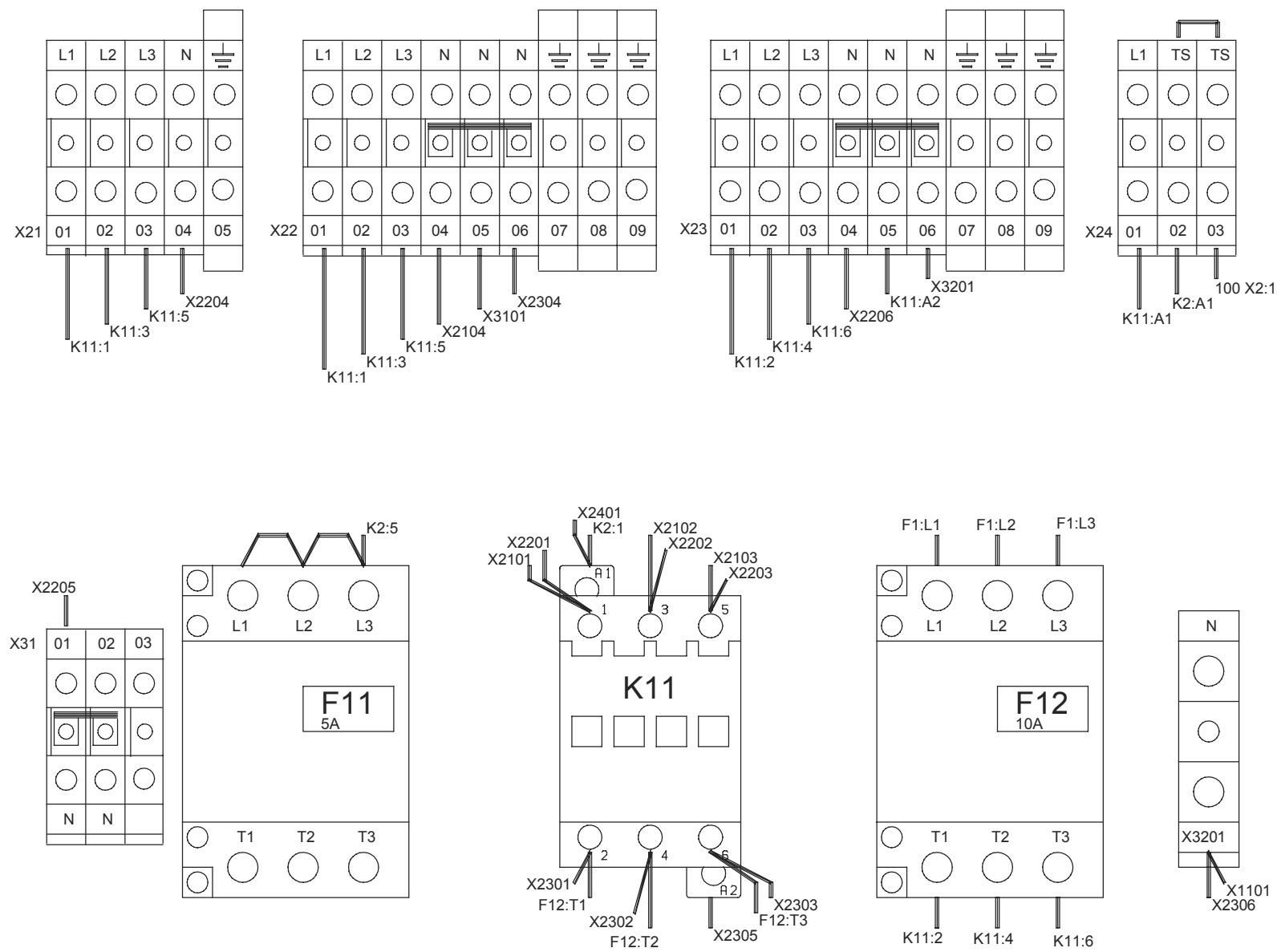


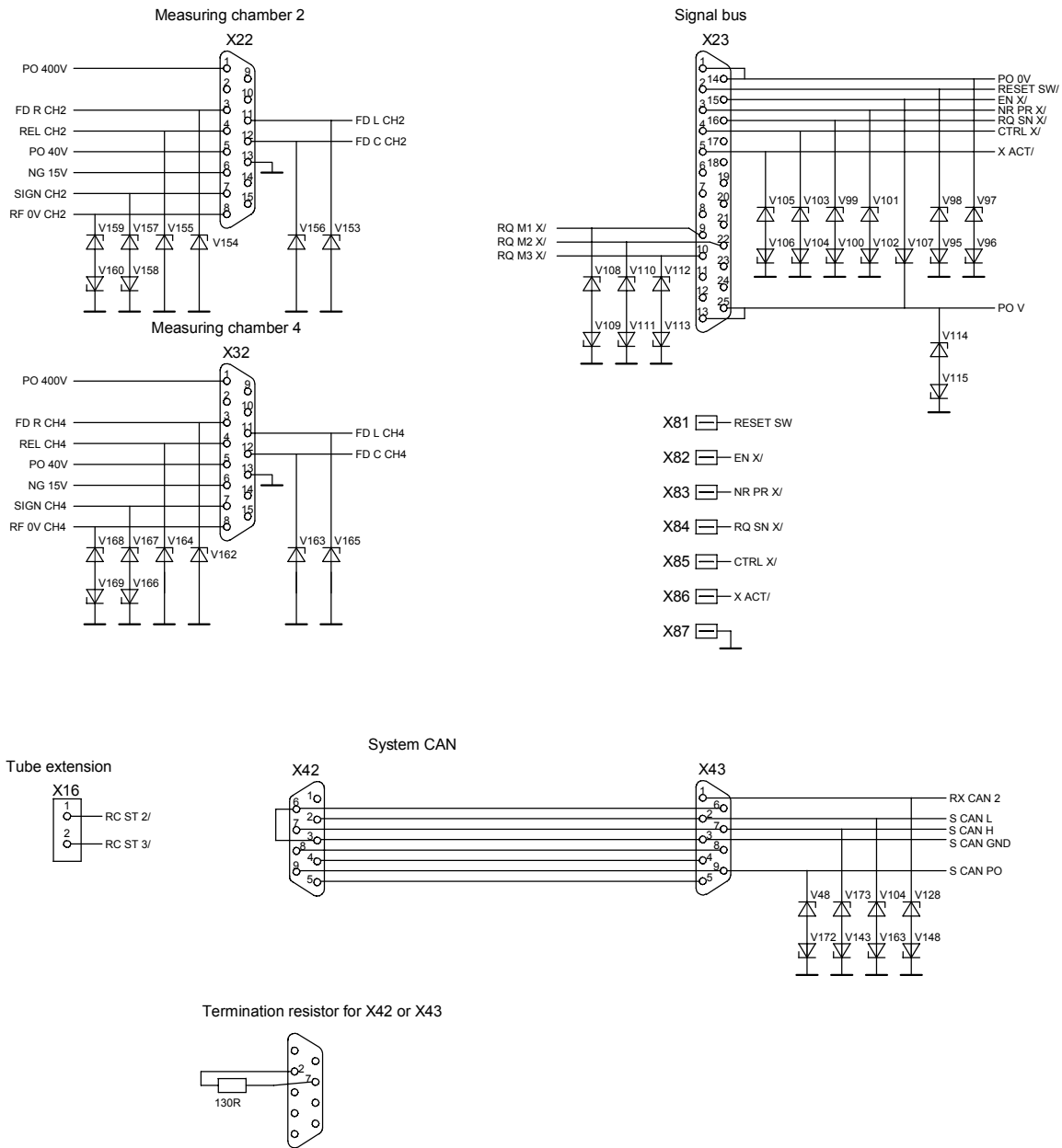
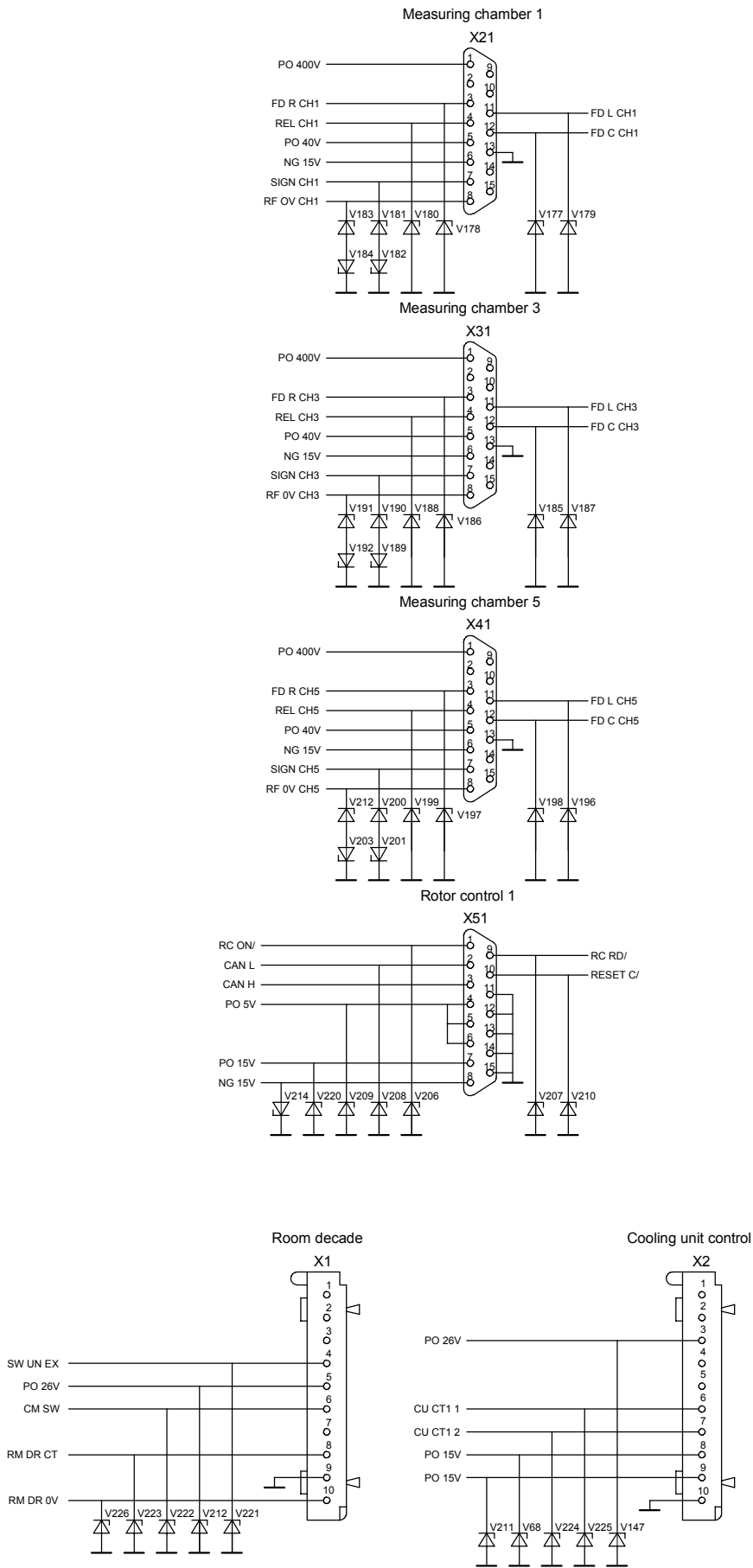
E
Earthing diagram





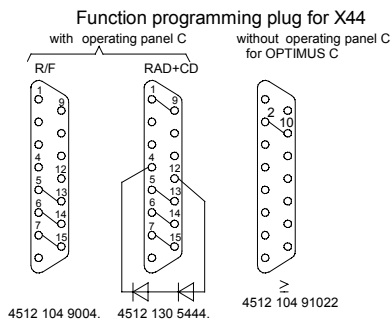
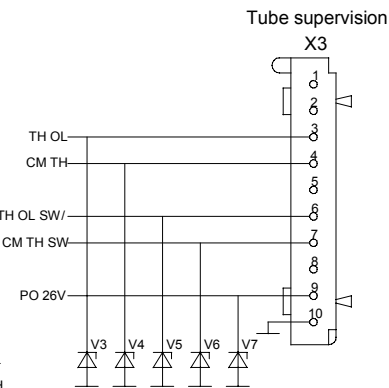
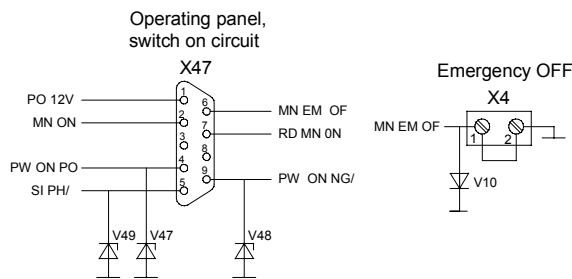
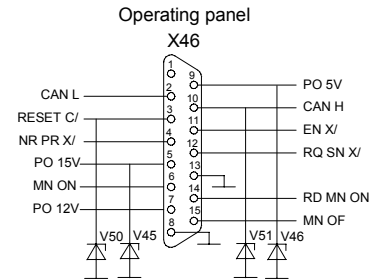
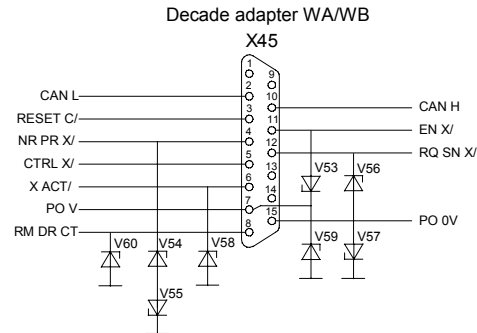
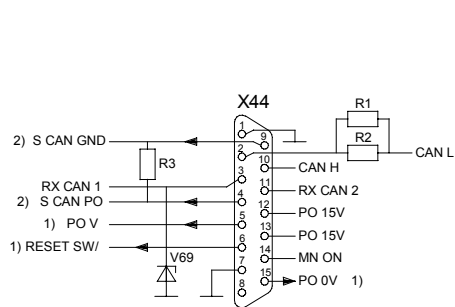
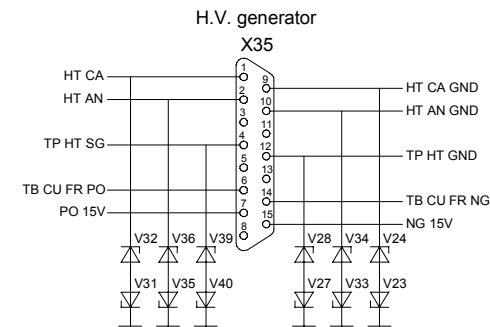
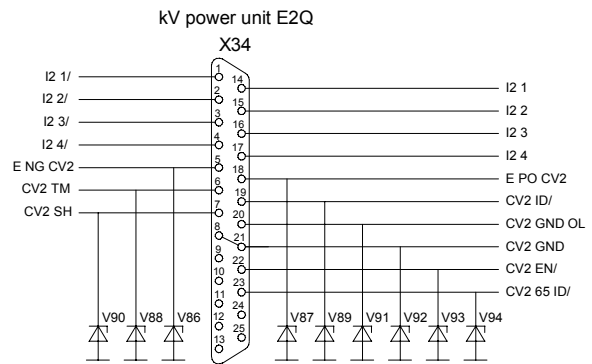
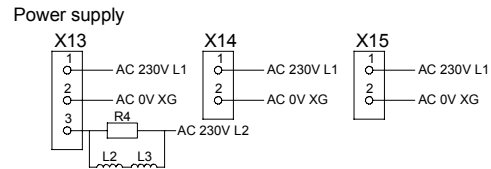
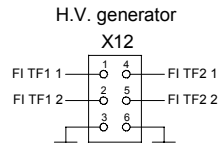
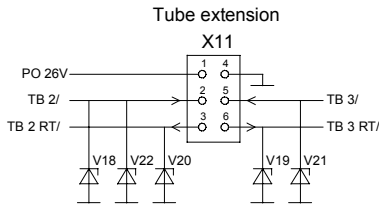
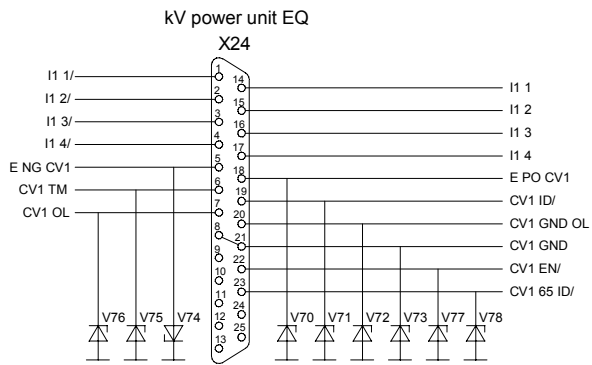




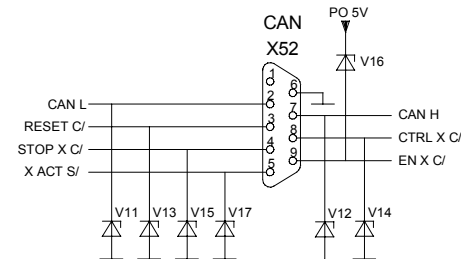
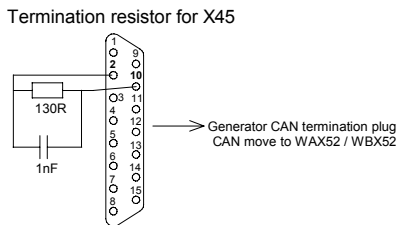


For survey of the components see Z2-5.4

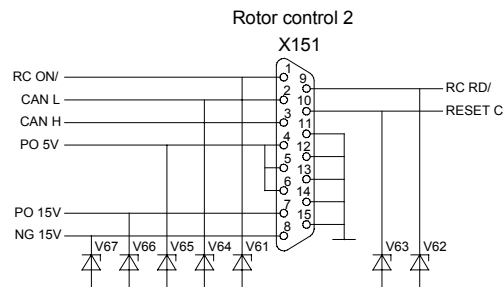
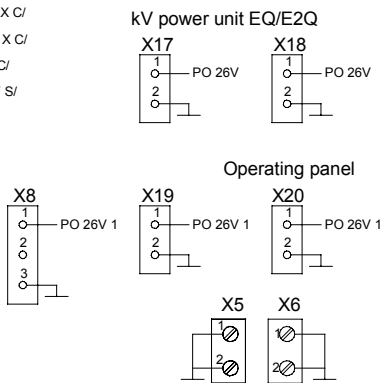
Backpanel
Basis rack-2 Z
4512 108 0936.



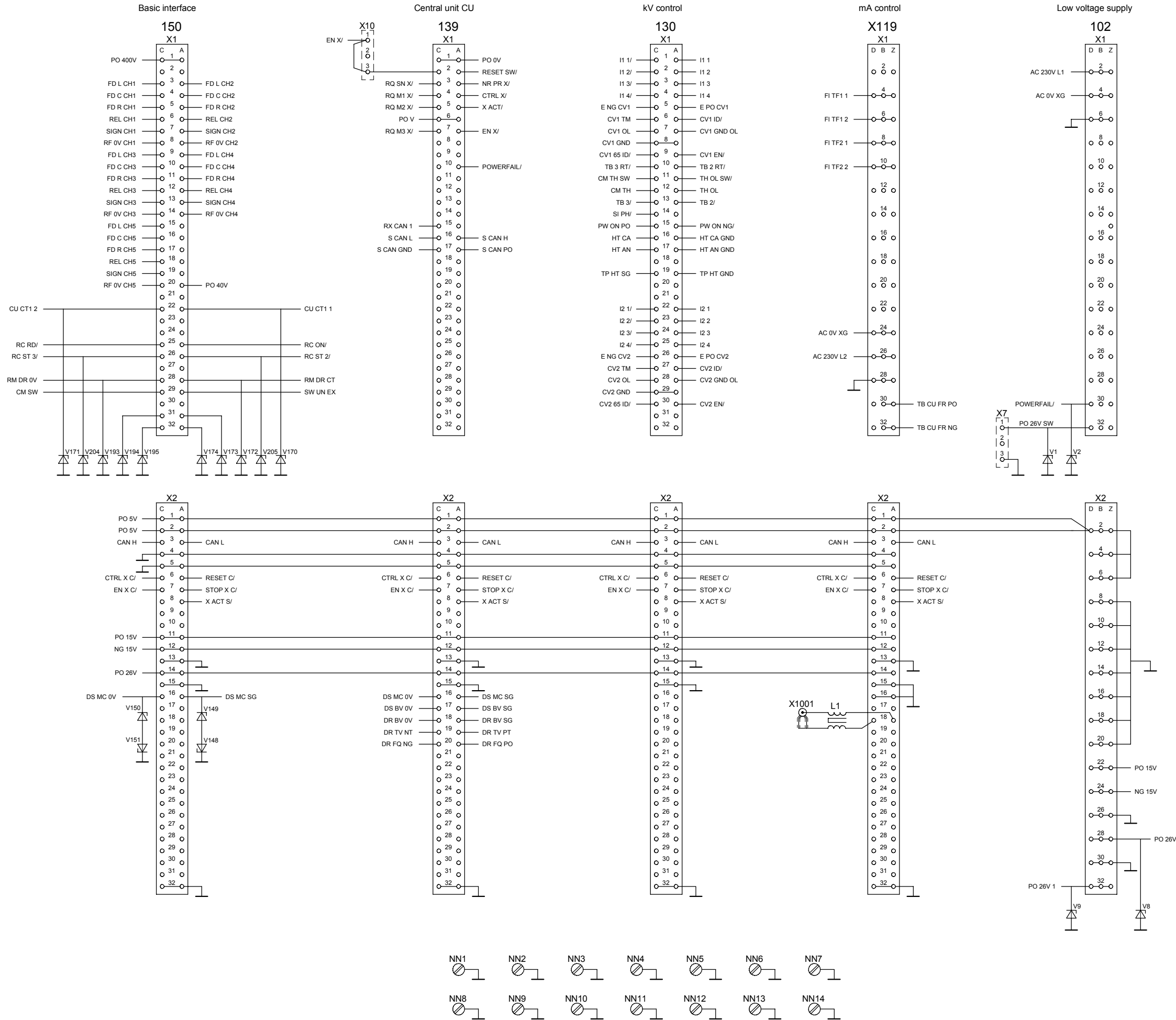
- 1) To Signal Bus X23
- 2) To System CAN X43



- X71 CAN L
- X72 CAN H
- X73 RESET C/
- X74 CTRL X C/
- X75 STOP X C/
- X76 EN X C/
- X77 X ACT S/



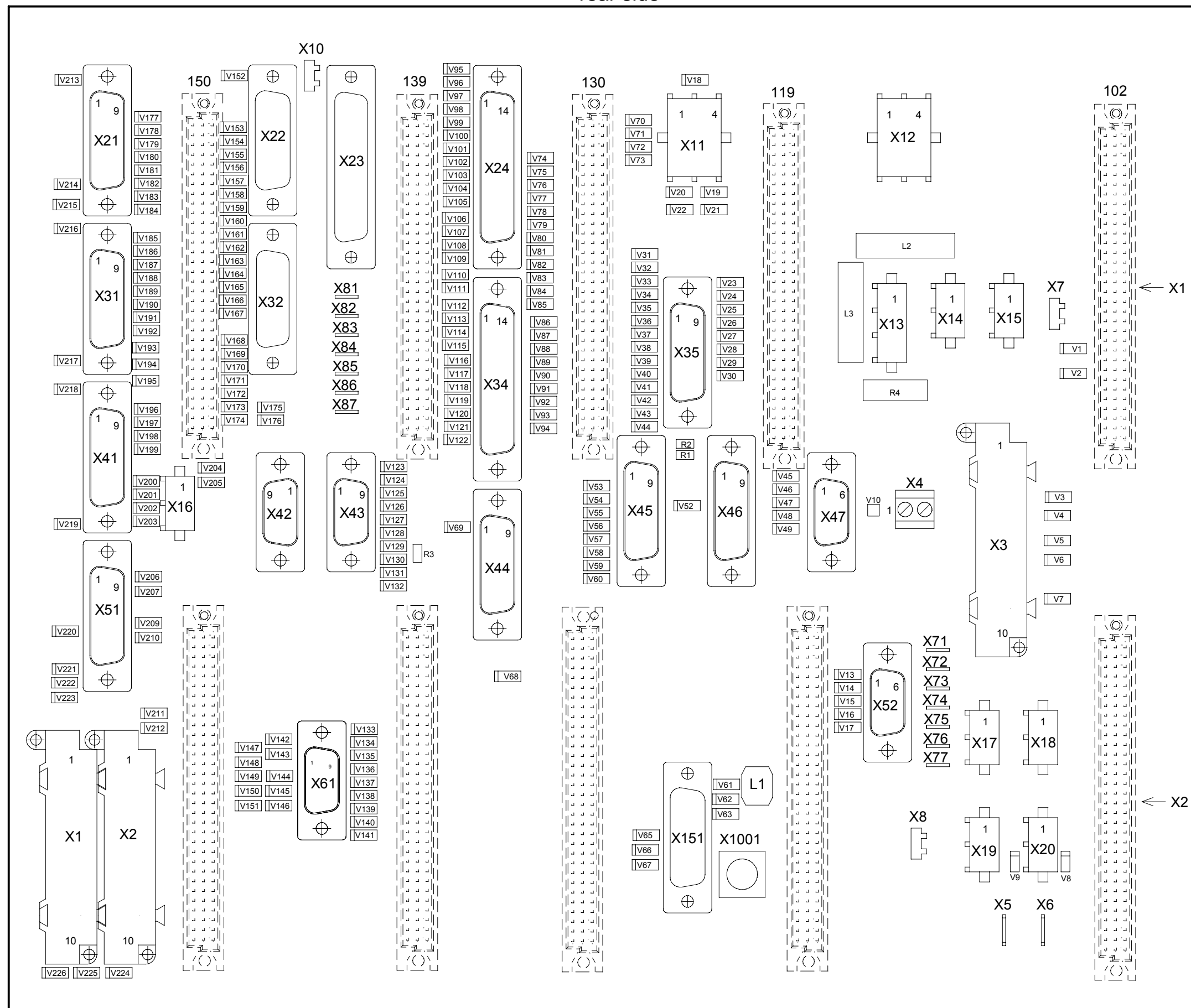
For survey of the components see Z2-5.4



For survey of the components see Z2-5.4

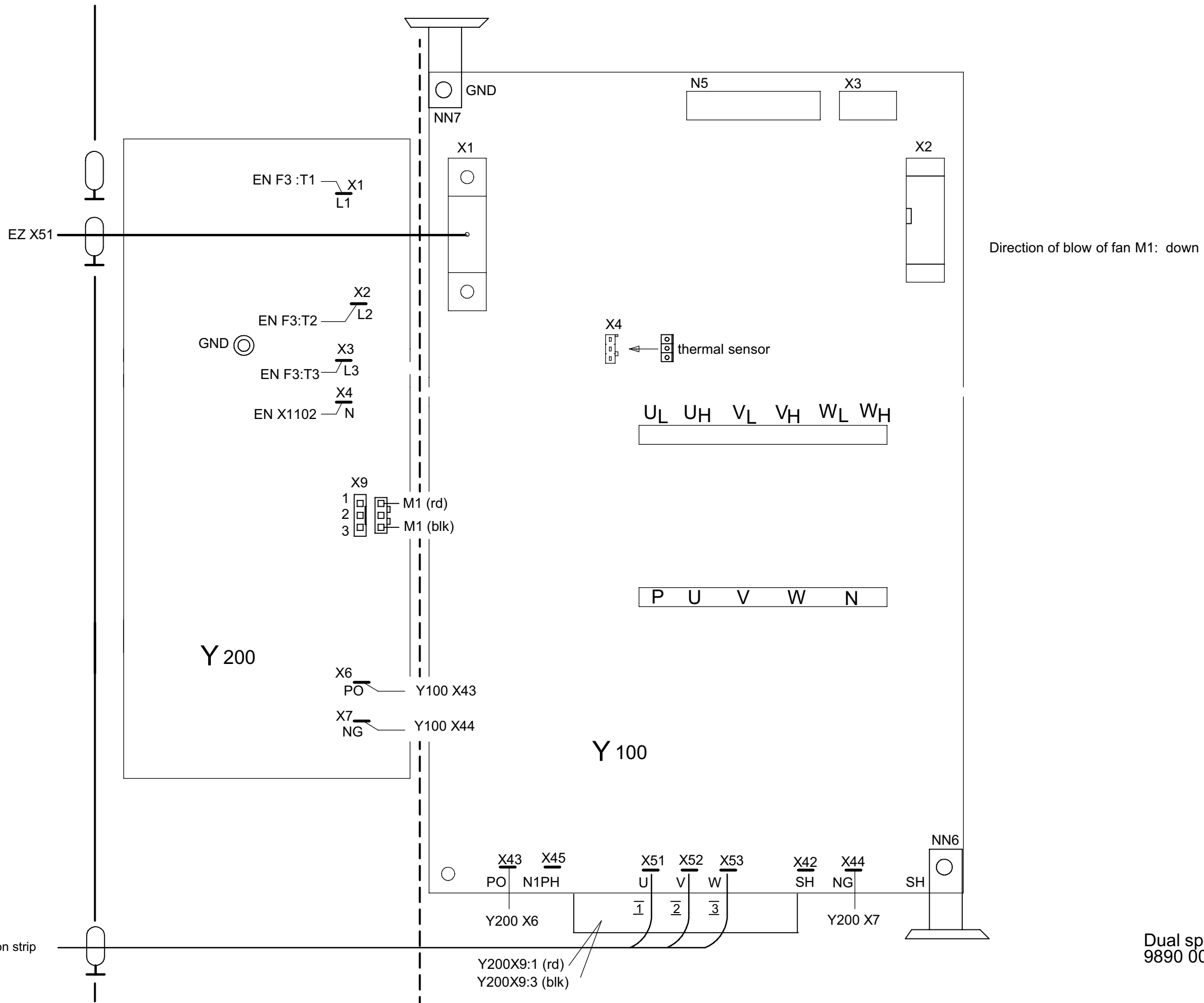
Backpanel EZ
Basis rack-2 Z
4512 108 0936.

rear side

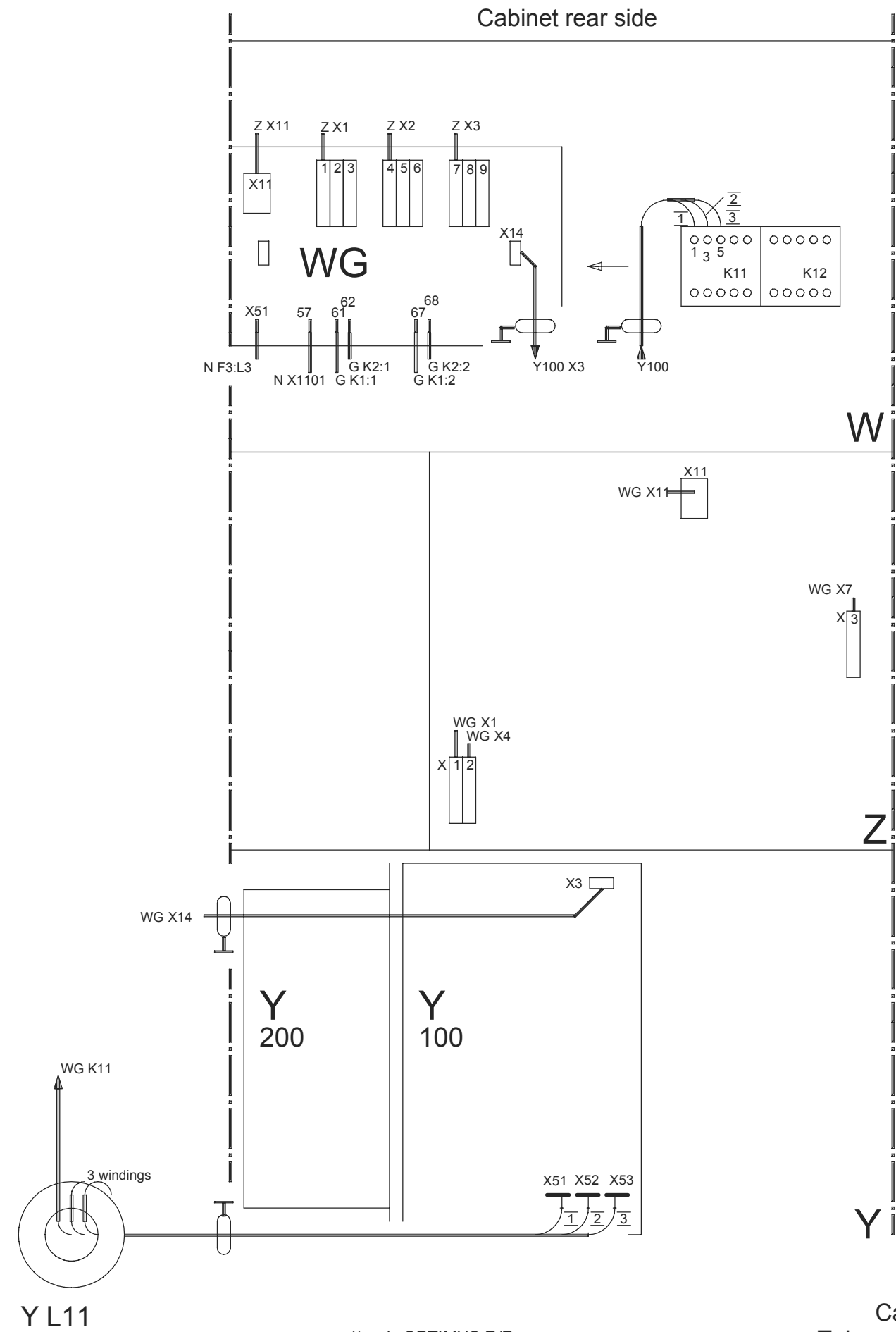
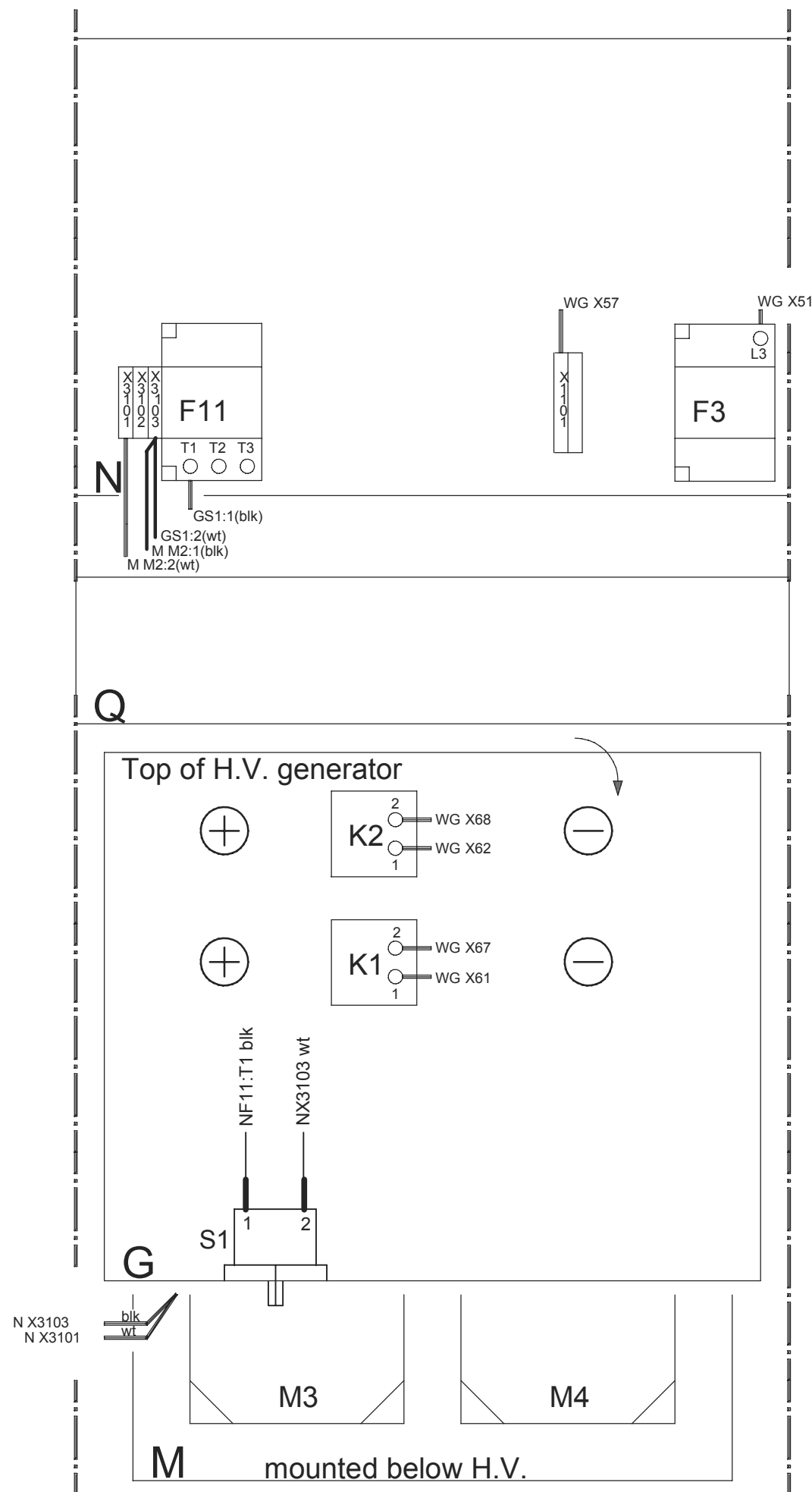


Backpanel EZ
Basis rack 2 Z
survey of components

Stator cable to
intermediate connection strip
or tube extension



Y
Dual speed rotor control
9890 000 0268x



1) only OPTIMUS R/F

Cabinet wiring
Tube extension WG ¹⁾
+ air coolers H.V. generator

wiring side

